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ABSTRACT

This report presents existing workforce levels, training programs and career potentials and develops staffing level projections (1976-1982) based on available information for the State of Arizona. The study concerns itself with the environmental pollution control areas of air, noise, potable water, pesticides, radiation, solid waste, wastewater, and energy. The format includes workforce profiles, projections, growth and career options for each of the areas investigated. Additional sections of the report outline state legislation and selected post secondary institutions with formal Environmental/Energy programs. A state profile and summary is included for cross-reference. The selected bibliography is appended in the Region IX report. This document is one in a series of 63 which presents information for each of the states, Washington, D.C., Puerto Rico, and the Virgin Islands, and national and regional summaries. (CS)

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A National Environmental/Energy Workforce Assessment

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SE 023 294

NATIONAL ENVIRONMENTAL/ENERGY

WORKFORCE ASSESSMENT

for

ARIZONA

Conducted by:

NATIONAL FIELD RESEARCH CENTER, INC

Under Grant from:

UNITED STATES

ENVIRONMENTAL PROTECTION AGENCY

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1977

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PREFACE

This study presents an analysis of existing workforce levels, training programs, and career potentials and develops five-year staffing level projections (1976 to 1982) based on available information for the State of Arizona in the environmental pollution control areas of air, noise, pesticides, potable water, radiation, solid waste, wastewater, and energy. This report is one portion of a study of the fifty states, Puerto Rico, and the Virgin Islands that was conducted by National Field Research Center, Inc. of Iowa City, Iowa.

The data presented in this report was compiled through comprehensive, on-site interviews with professionals working in the public and private sectors. Supplementing this method were telephone surveys, mail contacts, program plans, and research of relevant literature. It should be pointed out that the data, where not documented by records, represent the best professional judgement of these experts.

FOREWORD

Information for this report was largely compiled from on-site interviews with professionals within Arizona's state agencies with environmental protection functions and with professionals engaged in pollution control activities in the private sector. To strive for a higher degree of reliability, interviews were supplemented with telephone research. It should be noted that a large portion of the information contained herein represents the best professional judgements of those persons surveyed. The term "sources in the field" is used in this report to denote the pollution control professionals who provided information for the project. In cases in which more than one person provided input into a single program area, compilation of figures and recommendations was provided by the author. Much of the background material on agency programs, functions, and activities was obtained from program plans of the appropriate agencies.

This report provides information on the following eight pollution control fields: air, noise, pesticides, potable water, radiation, solid waste, wastewater, and energy.

Within the agencies and industries that were researched, compartmentalization of employees into the eight pollution control areas is not necessarily a clearcut situation. Functions occasionally overlap, inter-division cooperation occurs, and certain components serve a supporting role to an entire agency. Efforts were made in the

preparation of this report to provide sufficient information for the reader to have an understanding of those segments of the workforce that play a major role in environmental protection activities and to provide divisions in a logical, realistic, and understandable manner.

National Environmental Energy Workforce Assessment

Phase I

ARIZONA

State Summary

I. AIR

A professional and technical workforce of over 70 persons is engaged in air quality control in the Bureau of Air Quality Control (BAQC) and Bureau of Vehicular Emissions Inspection (BVEI) of the Arizona Department of Health Services (ADHS) and in seven local programs. An estimated 70 persons are employed by private industry to work in air pollution control, approximately 115 emission inspectors are employed by contractors to the BVEI, and 600 to 700 auto mechanics devote part-time to emissions inspection.

While the state estimates that 130 person-years of effort are necessary to carry on the SIP, no more than 60 persons are likely to be available from the BAQC and the BVEI. Projected annual workforce growth in the public sector over the next five years is minimal: 5 percent for the BAQC, none for the BVEI, and 10 percent for local programs. These projections represent a growth of about 37 total positions. To meet increasingly stringent air pollution regulations, the private sector workforce will grow by about 10 percent per year or by no more than 44 positions. Thus, fewer than 100 professionally and technically trained people will find job opportunities in the air pollution control field in the next five years.

The following training needs have been identified for air pollution control personnel: a) adjustment of emission control systems; b) communication and writing skills; and c) environmental law.

II. NOISE

There is a definite lack of activity in environmental noise control in Arizona at the present time. No noise legislation exists at the state level, although attempts have been made by the ADHS to obtain regulatory responsibility for noise control and to establish noise standards. Sources in the field anticipate that state noise legislation will be passed by the State Legislature in about five years. Currently, the Arizona Department of Transportation appears to be the only state agency involved in noise control. A staff of two civil engineers conduct noise studies for all highway construction projects in accordance with federal regulations. Four cities have municipal noise ordinances which are enforced by local law enforcement personnel, usually in response to complaints. Unless public awareness or national policy force the development of environmental noise control regulations, there will be little workforce growth in this area. If development in this field should occur, there will be a need for trained scientists, engineers, planners, systems analysts, attorneys, administrators, and technicians. Since little professional training and virtually no technical level training is presently available in the state, should this field expand, training programs will be necessary for involved personnel of all professions.

III. PESTICIDES

In the public sector in Arizona, at least seven state and county boards or departments are responsible for pesticide control. The state lead agency for the certification program is the Board of Pesticide Control, and the University of Arizona Cooperative Extension Service trains commercial and private applicators as well as pesticide advisors. In total, nearly 150 public sector professional and technical personnel are engaged in pesticide control activities. The Board of Pesticide Control estimates that 2,805 commercial applicators and 1,000 private applicators may need certification to achieve the requirements of federal and state legislation. In addition, 550 licensed pest control advisors serve as sales representatives for pesticide dealers and distributors, technical representatives for manufacturers, and public and private consultants.

While public sector sources anticipate some staffing growth as a result of FIFRA requirements, it appears that this growth will be limited. Growth that does occur will be primarily for degreed agricultural scientists or for persons with a knowledge of the pesticide industry to serve as field inspectors. Commercial applicators are projected to increase at a rate of no more than five percent per annum or about 100 per year. The stringency of FIFRA requirements may be responsible for restricting growth of commercial applicators.

IV. POTABLE WATER

The water supply regulatory program is administered by 15 professional and technical staff members of the Bureau of Water Quality Control (BWQC), ADHS. Eight of the 15 positions were filled in 1976 under an EPA grant pursuant to the Safe Drinking Water Act. Arizona has 745 treatment plant operators certified under the state's mandatory certification program. It is estimated that a total of approximately 1,000 persons work in the field of water supply in Arizona in the public and private sectors.

Sources at the BWQC indicate that a doubling of staff is necessary to adequately carry out the water supply program under the Safe Drinking Water Act, but because of insufficient state and federal funds, no further staff growth will occur over the next five years. More stringent enforcement of existing regulations combined with the requirements of the Safe Drinking Water Act will necessitate a significant increase in the number of certified treatment plant operators. All classifications of operator are projected to increase at an average per annum rate of 15 percent over the next five years or by 150 operators per year. Supervisory, maintenance, and laborer positions are also expected to increase as well as positions for chemist and laboratory technicians in state and private laboratories.

V. RADIATION

Most public sector radiation control activity is conducted by the Arizona Atomic Energy Commission (AAEC). The AAEC has a professional and technical staff of ten persons including health physicists and radiation control technologists. Comprehensive information regarding private sector workforce figures is not available. Field research suggests that there are at least 13 radiation control technicians, that is, persons who monitor personnel, plant facilities, work environment, and plant vicinity to detect and control radioactivity and/or radiation exposure and perform operation, analysis, and calibration of radiation monitoring equipment.

Workforce growth in radiation protection will result primarily from the planned construction of three nuclear generating stations by the Arizona Nuclear Power Project. The AAEC expects to grow by five persons over the next five years. New positions will be for chemists and physicists and a radiation control technologist. When the prospective nuclear power plants are operating, the workload of the AAEC may increase by 400 percent. In the early 1980s, when the nuclear power plants become operational, employees are expected to number about 300. Some of these persons will be involved in protection of the plant and external environment from radiation.

VI. SOLID WASTE

Because of the abundance of land in Arizona, land disposal of solid waste is the predominant disposal method, and resource recovery operations are limited. Currently, the state regulatory program, administered by the Solid Waste Management Section (SWMS) of the ADHS has a professional staff of two. Approximately 160 persons work at the state's 144 approved landfills in such positions as weighmaster, heavy equipment operator, foreman, and spotter. It is estimated that 1,500 persons may be engaged in solid waste collection.

The SWMS anticipates increasing its staff to nine positions by 1981. New positions will be for hydrologists, chemists, and sanitarians to expand the section's enforcement, technical assistance, and hazardous waste management activities. No workforce growth will occur in collection, and it is likely, in fact, that this workforce will decrease as more capital intensive technology reduces the traditional three-person crew to one-person. The workforce in disposal will grow slowly over the next five years at a projected per annum growth rate of three percent, thus yielding a total increase of about 23 people. The rate of turnover of the workforce in disposal may be as high as 30 percent per year for heavy equipment operators and spotters because of frequent injuries, low pay, and little opportunity for advancement.

VII. WASTE WATER

The Arizona Department of Health Services, Bureau of Water Quality Control has regulatory responsibility for both the waste water pollution control and water supply programs. A total of 17 professional and technical personnel are involved in the waste water pollution control program. The position of engineer predominates the program. Officials indicate that the bureau has a need for a doubling of staff to effectively carry out its functions. However, due to inadequate funding, no additional positions are expected to be authorized in the next five years.

There are currently a total of 532 certified operators employed in waste water treatment facilities. Sources indicate that more stringent enforcement of existing state and federal regulations combined with plant construction and modifications and changes in treatment technology will result in the need for more and better trained certified treatment plant operators over the next five years, with an average annual increase of 25%. This translates into a growth of approximately 214 persons per year.

There will also be an increased demand for other waste water treatment personnel in such areas as administration, maintenance, and general labor. There may also be some growth in the number of laboratory personnel required. However, specific workforce projections for these areas cannot be made from the available information.

VIII. ENERGY

The Arizona State Government has three principal energy-related organizations: The Office of Economic Planning and Development, Planning Division, Energy Programs Section; the Arizona Solar Energy Research Commission; and the Interagency Energy Planning Office.

The Energy Programs Section has a staff of six professionals which includes a fuel allocation officer, two natural gas project members, and two conservation planners. The Section expects to experience no growth over the next five years, and in fact, may lose three positions if federal funding ceases.

The Arizona Solar Energy Research Commission has a professional staff of three persons: the executive director, a deputy director, and a public information coordinator. Authorization for ASERC expires in 1978, but sources expect that authority for the Commission will be renewed.

The Interagency Energy Planning Office has a membership of 20 representatives. This office does not have a supporting staff.

Specific workforce figures for the private sector are not available. However, sources in the field argue that significant growth will occur in solar and other energy development such as geo- and hydro-thermal in approximately three to five years.

STATE OF ARIZONA - SUMMARY

National Environmental/Energy Workforce Assessment
Pollution Control & Abatement Personnel
Projected Workforce Requirements (1976-1981)

Environmental Area	1976	1977	1978	1979	1980	1981	%/annum growth (average)
AIR[1]	252	268	278	288	300	313	4%
NOISE[2]	2	2	2	2	2	2	0
PESTICIDES	7,511	7,666	7,821	7,977	8,133	8,289	2%
POTABLE WATER[3]	760	909	1,058	1,207	1,356	1,505	15%
RADIATION[4]	10	10	10	12	14	15	9%
SOLID WASTE[5]	2	4	7	8	9	9	n/a
WASTEWATER[6]	547	761	975	1,189	1,403	1,607	24%
ENERGY[7]	9	9	6	6	6	7	n/a
TOTALS	9,093	9,629	10,157	10,689	11,223	11,747	5%

1 This estimate does not include the 600-700 mechanics involved with private sector emissions control.

2 This estimate includes projections for the Department of Transportation; no information is available on the private sector workforce.

3 The above figure includes estimates for the state agency and for water treatment plant certified operators.

4 The above does not include private sector projections.

5 The above includes only state agency estimates. Private sector information is limited, and currently includes an estimated 144 landfill owner/operators, 99 heavy equipment operators, 10 weighmasters, 9 foreman, 23 spotters, and 19 others. Minimal growth is projected during the coming five years.

6 The above estimate includes only the personnel projections for the state lead agency and the water treatment plant certified operators.

7 This estimate includes information on the state agencies. Limited data are available on the private sector.

EDUCATION

Environmentally related education programs are available only on a limited basis in Arizona. Northern Arizona University offers a Bachelor of Science degree in Environmental Studies. This program represents an interdisciplinary program effort, which has been designed to prepare students for environmental science vocations in government, industry, and teaching. The Division of Agriculture of Northern Arizona University offers both a B.S. and M.S. degree in Environmental Resources in Agriculture.

Pima Community College District is designing a curriculum for one-year certified wastewater treatment plant operator training. This program is being developed with the intent of replicating the curriculum in any Arizona community college interested in implementing such a program.

Phoenix College has a well-developed Water Treatment Training Program. The college offers both a certificate and A.A.S. degree. This program has been operable since 1965.

Other than the programs mentioned, environmental education programs are rare. Many colleges and universities in the state offer individual courses in ecology, man and his natural environment, and environmental science; however, little in the way of comprehensive environmental program majors is available.

LEGISLATION

The environmental/energy legislation for Arizona was obtained by request from various agency personnel and through various library references. Summaries of the legislation deemed most relevant to the eight subject areas of the workforce assessment were prepared, and are included in the respective state reports. The following list of laws represents virtually all environmental legislation for the state. Only certain of the following laws were summarized; the list is presented to show, by title, the kinds of laws which have been enacted.

Environmental Planning Office Act

Air Pollution Control Act

Mandatory Annual Emissions Inspections of Motor Vehicles

Motor Vehicle Emissions Inspection Facilities

Air Pollution Control Devices

Assumption of Jurisdiction Over Indian Lands for Air Pollution Control

Mufflers Prevention of Noise and Air Pollution

Arizona Pesticide Act

Pesticide Use and Application Law

Structural Pest Control Law

Control of Ionizing Radiation Law

Public Dumping Grounds Law

Solid Waste Management Plans Law

Sanitary Districts Law

Water Pollution Control Act

Arizona Solar Energy Research Commission Law

National Environmental Energy Workforce Assessment

Phase I

ARIZONA

State Report

STATE PROFILE

The State of Arizona, ranking sixth in size and 32nd in population, was the last of the contiguous states to be added to the union. A state of contrasts between old ways and modern, urban and rural, rich and poor, Arizona is rapidly undergoing urban expansion and population growth. Environmental and economic concerns are growing equally rapidly.

Although the state has a long history as a desert area and a reputation rooted in southwestern lore, its current economic status depends on agriculture, mining, and large modern urban developments in Tucson, Phoenix, and surrounding communities. More than one-half of the state's population live in these urban areas. Contrasting with the relatively wealthy city dwellers are the large numbers of Indians, Mexican-Americans and black Americans whose average income level is well below the national average.

The state has developed an extensive manufacturing base to support its economy. Copper mining, aeronautical and electrical manufacturing, and aluminum products fabrication are important to the population's income. This industrial base has greatly expanded in the years since World War II and has put a heavy strain upon the water supply of this semi-arid state. Combined with the environmental pressure exerted by vast areas of agricultural land under irrigation, the problems of water supply management dominate Arizona's environmental picture. However, air pollution is also a problem in the urban areas and will continue to be of concern to residents.

Two-thirds of the state lies in arid to semi-arid climate zones. These zones have been heavily irrigated with water supplied primarily from Colorado River sources. The irrigation has led to water disputes with California, but importantly, it has also made agricultural and cattle production a major and stable factor in Arizona's economy. The federal government controls 45% of Arizona's land area and holds in trust another 27% of the land in the form of Indian reservations. Personal income resulting from government expenditures in connection with this huge proportion of the state's area exceeds that from mining and agriculture combined.

ARIZONA POLLUTION CONTROL AND ABATEMENT AGENCIES

The Arizona Department of Health Services is the principal state environmental agency. This Department has primary responsibility for the air, potable water, solid waste, and waste water programs. Additional state agencies or organizations concerned with environmental protection include the Board of Pesticide Control, the Structural Pest Control Board, the Arizona Atomic Energy Commission, the Office of Economic Planning and Development, the Arizona Solar Energy Research Commission, and the Interagency Energy Planning Office.

In the Department of Health Services, the pollution control activities are located in the Division of Environmental Health Services. This Division has four bureaus, the Bureau of Air Quality Control, the Bureau of Vehicular Emissions Inspection, the Bureau of Sanitation, and the Bureau of Water Quality Control.

The first bureau is responsible for the assurance and maintenance of ambient air quality in Arizona, and the second bureau is responsible for the control of vehicular emissions. The Bureau of Vehicular Emissions Inspection was established in 1974 and has authority to operate its inspection program in Maricopa and Pima Counties. Although the original legislation provided for the expansion of the program into other counties as necessary, 1976 amendments ended the bureau's authority for program expansion.

The Bureau of Sanitation conducts the solid waste management program. Hazardous waste management and assurance of proper land

disposal methods are the priority activities of this bureau. The Bureau of Water Quality Control has responsibility for both the potable water program and waste water control program. This bureau will attempt to assume primary enforcement responsibility for the Safe Drinking Water Act. Because of construction programs, more stringent legislation, and more strict enforcement of existing regulations both water supply and waste water treatment facilities are expected to experience significant staffing growth, and the Bureau of Water Quality Control is becoming involved in expanding the training available to treatment facility personnel.

The Division of Environmental Health Services has a professional and technical staff of over 100. This staff includes engineers, chemists, sanitarians, meteorologists, air pollution control technicians, auto emission control technicians, and equipment mechanics.

The state lead agency for the pesticide applicator certification program is the Board of Pesticide Control. This agency also is responsible for regulating the use of agriculture pesticides. The Structural Pest Control Board regulates structural commercial applicators and assists with the certification program. Together, these two boards have six professional staff members who hold the positions of administrator, field inspector, and accountant.

The Arizona Atomic Energy Commission is responsible for the regulation and control of all sources of radiation, both ionizing and non-ionizing, in the state. The professional and technical staff of this agency consists of ten members, who are health physicists and

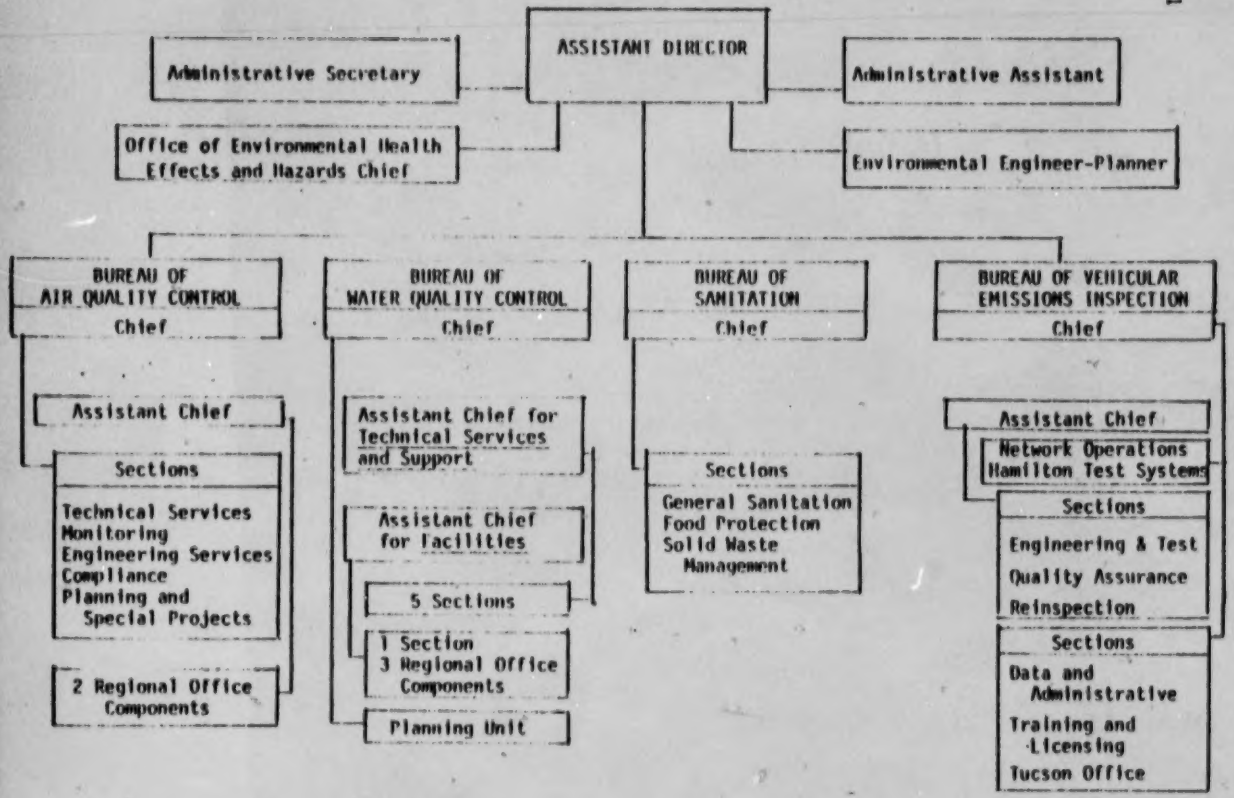
radiation control technologists. The Commission will become increasingly involved in nuclear power plant monitoring in the 1980s as a result of the planned construction of three nuclear generating units. The three units will be located 45 miles west of downtown Phoenix. The facility has been named the Palo Verde Nuclear Generating Station.

Energy planning and development for the state is carried out by several agencies. The Energy Programs Section of the Office of Economic Planning and Development is responsible for energy policy planning and is developing a statewide energy plan as mandated by the federal government. The Arizona Solar Energy Research Commission was established to conduct and encourage solar energy research, and the Interagency Energy Planning Office is concerned with coordinating energy activities among 20 state agencies. The staffs of the first two offices have a total of nine professional members. The Interagency Planning Office is composed of representatives of 20 agencies and does not have a supporting staff.

ARIZONA DEPARTMENT OF HEALTH SERVICES

DIVISION OF ENVIRONMENTAL HEALTH SERVICES

Figure 1



Pollution Control and Abatement Programs

I. AIR

A. Introduction

Arizona has two major air pollution problems. One is from automobile emissions in the cities, particularly in Maricopa and Pima counties where Phoenix and Tucson are located. These two counties have an estimated 1.3 million vehicles. The other air pollution problem results from the activities of the seven copper smelters in the state. The most serious air pollution problem caused by the smelters is sulphur dioxide. The smelters are located in outlying, sparsely populated areas, and their emissions are gradually decreasing. A third, but less serious air pollution problem is caused by dust. Because of the arid climate, there is much particulate matter of this nature in the air. This problem is mostly a natural occurrence, and there is not much that can be done about it. Traffic activity contributes to the dust problem, but it is estimated that six billion dollars would be required to pave major roads adequately enough to help alleviate the problem.

To deal with air pollution on the state level, the Arizona Department of Health Services has established two separate air pollution control bureaus in the Division of Environmental Health Services. They are the Bureau of Air Quality Control and the Bureau of Vehicular Emissions Inspection. As their names imply, the first bureau is responsible for the assurance and maintenance of ambient air quality in the state and the second bureau is responsible for the control of vehicular emissions. In addition, seven Arizona counties conduct local air pollution control programs. In the private sector, the copper, cement and electric

power industries conduct the majority of air pollution control activity and employ the largest workforce in this area.

B. Workforce Profile

The goal of the Bureau of Air Quality Control, as stated in the Division of Environmental Health Services M.B.O. program document for 1976-1977 is to assure the attainment and maintenance of ambient air quality in the State of Arizona at a level consistent with the standards necessary for the protection of the health and welfare of the citizens. The objectives of the bureau include the following:

1) To provide the regulatory mechanism for air quality control;

2) To operate the permit program for the review of existing, new, and modified sources under state jurisdiction to assure compliance with regulations. There are over 100 sources currently under state permits;

3) To monitor air quality for ambient concentrations of particulates, sulphur dioxide, nitrogen dioxide, oxidants, carbon monoxide, and hydrocarbons. 43 monitoring sites are operated by the bureau and information is received from an additional 102 sites;

4) To provide an emergency episode program;

5) To administer the State Air Pollution Control Implementation Plan;

6) To verify the compliance status for all sources over 100 tons per year potential air pollutant emissions and to maintain a current emissions inventory for such sources. A total of 171 sources are reported to EPA;

7) To provide assistance to counties in handling air pollution problems.

The bureau is divided into five sections: technical services, monitoring, engineering services, compliance, and planning and special projects. It operates through the main headquarters in Phoenix, which has a professional and technical staff of 23 and three professional and technical members in two field offices, the Northern Regional Office and the Southern Regional Office.

The Bureau of Air Quality Control is composed primarily of environmental health engineers, chemists, and air pollution control technicians. The distribution of personnel among bureau positions is shown in the following table:

TABLE I

ARIZONA DEPARTMENT OF HEALTH SERVICES

Bureau of Air Quality Control
Current (1976) Staffing Level

Position	1976
Engineer	11
Meteorologist	1
Scientist	4
Technician	7
Other	3
TOTAL	26

The engineers hold positions designated either as public health engineer or public health engineering assistant. The former requires professional registration as an engineer. The five public health engineers are registered professional engineers, while the six engineering assistants are not. Training includes mechanical, civil, and chemical

engineering. The scientists are degreed chemists, and one is provided by the state health laboratory in the Bureau of Epidemiology and Laboratory Services of the Division of Disease Control Services. The technicians work as air pollution control technicians and have either an associate's degree or have acquired on-the-job training in an industrial setting. The 'other' category includes two administrators, both of whom are registered professional engineers, and one statistician. In addition, the bureau purchases the services of one attorney from the Attorney General's Office.

Five authorized positions are vacant. Vacancies include two engineering positions, one chemist, and two technicians.

Seven county agencies conduct air pollution control activities. They are the counties of Coconino, Maricopa, Mohave, Greenlee, Graham, Pima, and Yuma. There is a Pinal-Gila Counties Air Quality Control District. The Pima County program is the largest with a staff of approximately ten. The other programs' staffs range from a part-time engineer or inspector to two employees. A total of approximately 17 professional and technical staff composes the county porgrams. Positions represented in these programs are shown in the following table:

TABLE II

COUNTY AIR POLLUTION CONTROL PROGRAMS

Current (1976) Staffing Level

Position	1976
Engineer	5
Attorney	1
Scientist	1
Technician	7
Sanitarian	2
Other	1
TOTAL	17

ARIZONA DEPARTMENT OF HEALTH SERVICES
DIVISION OF ENVIRONMENTAL HEALTH SERVICES
BUREAU OF AIR QUALITY

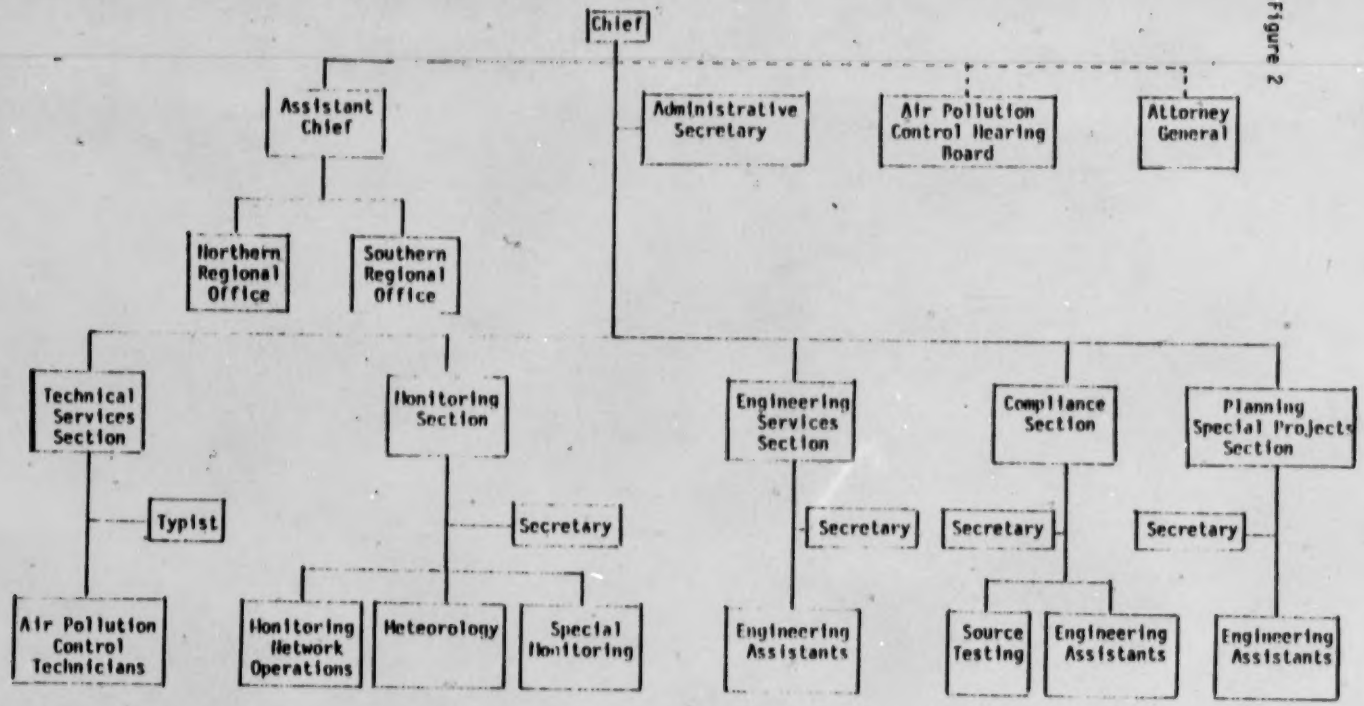


Figure 2

The scientist is a chemist; the technicians work as air pollution control inspectors, and the one position in the 'other' category is filled by an administrator.

The Bureau of Vehicular Emissions Inspection was established in 1974 to manage a vehicular emissions inspection program for the state. To date, the program applies only to the two most populated counties in the state, Maricopa and Pima. The goal of the bureau as stated in Division of Environmental Health Services M.B.O. program document for 1976-1977 is to direct a comprehensive annual, mandatory, vehicular emissions inspection program in Maricopa and Pima Counties. The original legislation provided for expansion of the program to other counties as needed, but 1976 amendments ended the Department's authority for program expansion.

The original legislation provided for a mandatory annual emissions testing program of all state and political subdivision owned vehicles operated in Pima and Maricopa Counties and testing for privately owned vehicles on a voluntary basis. The legislation also established a mandatory emissions inspection program for all privately owned light, medium, and heavy duty vehicles registered in Pima and Maricopa Counties beginning January 1, 1976, with mandatory compliance commencing January 1, 1977.

The bureau now administers the inspection program for 1.2 to 1.3 million vehicles annually. The inspection network is operated by a private company under contract to the Department of Health Services. Public and private fleet operators of 25 or more vehicles may operate their own test facilities, and the bureau inspects vehicles owned by

the state and political subdivisions. In addition, the bureau monitors all inspection stations and licenses vehicle inspectors and fleet stations.

The bureau is divided into five sections: Engineering and Test, Quality Assurance, Administration and Data, Training and Licensing, and the Tucson office. It is composed of 24 professional and technical staff members. Positions include engineers, technicians, training specialists, and data specialists. The distribution of personnel among the various positions is as follows:

TABLE III

ARIZONA DEPARTMENT OF HEALTH SERVICES

Bureau of Vehicular Emissions Inspection
Current (1976) Staffing Level

Position	1976
Engineer	4
Technician	11
Other	9
TOTAL	24

The engineers hold the position of public health engineer and have a variety of engineering backgrounds. The technical staff includes five air pollution control technicians, four automobile emission control technicians, and two equipment mechanics. The 'other' category includes the bureau chief, who is an engineer, five training specialists, statisticians, and computer programmers.

The engineers provide supervision and technical assistance to the technicians in the performance of such activities as inspection station surveillance, investigation of fleet inspection station applicants, vehicle emission testing on government owned vehicles, and investigation of vehicles failing mandatory compliance more than twice. The engineers also are involved in developing and establishing emissions standards and directing testing and evaluation to determine the variability of test results with various test conditions and the diagnostic capability of testing methods.

The air pollution control technicians are responsible for installing, repairing, and maintaining less complex sampling, testing, and indicating instruments and equipment, and participating in complex troubleshooting on electrical and electronic systems. They also conduct surveillance of official contractor-operated inspection stations and investigation of fleet station applicants. These technicians require auto mechanics training with an electronics and diagnostic background preferred.

The automotive emissions control technicians install, calibrate, service, and maintain a variety of specialized analytical and recording instruments for the detection of automotive emissions and diagnose automotive components as they relate to exhaust, crankcase, and evaporative emissions. Equipment mechanics also perform vehicle emission testing and inspection. Again, a background in automobile mechanics, electronics, and diagnostics is preferred.

The training specialists are former emissions control technicians and conduct training classes and seminars on vehicular emissions and automotive tune-up procedures for mechanics, instructors, inspectors, and the general public.

In order to obtain information concerning the workforce involved in air pollution control activities in the private sector, estimates were solicited from Department of Health Services personnel involved in the air management program and from selected private sector sources engaged in air pollution control programs. Information was obtained through on-site and telephone interviews. It should be noted that estimates represent the best professional judgement of sources in the field.

Public and private sector sources estimate that there may be up to 70 professional and technical personnel working in air pollution control in industry. The majority of this workforce is employed by the copper industry at the smelters, the electric power industry, and the cement industry. Approximately 50% of this workforce is engineers and scientists, specifically, civil, mechanical, electrical, and chemical engineers, chemists, and meteorologists. The other 50% of the workforce is composed of technicians, most of whom are skilled in instrumentation and electronics. Attorneys are also involved in air pollution control, but no workforce data on attorneys were available.

Air pollution control activities are carried out both by corporate environmental staffs and by plant engineering departments. Corporate environmental staffs are responsible for environmental policy planning, long-range planning of facilities and equipment, conducting environmental studies, preparing environmental reports for regulatory agencies, keeping top management informed of new rules and regulations, and providing technical assistance to plants in solving air pollution problems. Engineering departments are responsible for ensuring plant compliance with air pollution control regulations, air quality monitoring, and

operation and maintenance of air pollution control equipment. These departments are also reponsible for interior plant conditions, such as control of fumes and chemicals, in accordance with OSHA regulations, as well as control of ambient air pollution caused by plant operations.

Some of the professional and technical workforces do not devote full time to air pollution control. Rather, these personnel may be involved in other environmental control activities, and frequently, they perform other functions that are not related to environmental matters.

In filling professional positions in industry, companies tend to seek persons with experience in pollution control who have a knowledge of environmental regulations and technology. Consequently, recruitment is often conducted through advertisements in newspapers and professional journals, it may occur from within the company, or positions may be filled with persons recruited from governmental agencies. For technical positions recruitment often comes from within the company. Either persons who have the requisite skills or persons who are thought to be easily trainable are chosen.

With regard to control of air pollution caused by motor vehicles, about 115 full-time emission inspectors are employed by the contractor for the Bureau of Vehicular Emissions Inspection. Emission inspectors are licensed after passing an examination or completing a course of study approved by the Department of Health Services. In addition, fleet stations certified to conduct their own vehicular emission inspection employ between 600 and 700 auto mechanics who work as vehicle emission inspectors on a part-time basis as an adjunct to their other duties.

In summary, the majority of workforce involvement in air pollution control is occurring in the private sector, with most of the employment being for vehicular emission inspectors. In the private sector, there are an estimated 70 professional and technical personnel working in industry in air pollution control on either a full- or part-time basis, approximately 115 auto mechanics work full-time as emissions inspectors, and an additional 600 to 700 auto mechanics devote part of their time to emission inspection. In the public sector, over 70 professional and technical personnel are engaged in the state and local air quality control programs, with 24 of these personnel working in vehicular emission control.

C. Workforce Projections

Workforce projections regarding the state and local air quality control programs are based on the best professional judgement of persons involved in the state air program. Of particular assistance in compiling these estimates were Mr. Edmund C. Garthe, Department of Health Services, Division of Environmental Health Services; Mr. Nils I. Larson, Bureau of Air Quality Control; and Mr. R. Fred Iacobelli, Bureau of Vehicular Emissions Inspection.

Over the next five years, the Bureau of Air Quality Control expects no growth to occur other than the filling of the authorized positions that are vacant. Although the state estimates that 130 person-years would be necessary to carry out the state implementation plan, no more than 60 professional and technical personnel are expected to be available from both the Bureau of Air Quality Control and the Bureau of Vehicular

Emissions Inspection. Staffing projections for the next five years for the Bureau of Air Quality Control are shown in the table below:

TABLE IV

ARIZONA DEPARTMENT OF HEALTH SERVICES

Bureau of Air Quality Control
Workforce Projections to 1982 (est.)

Position	1976	1977	1978	1979	1980	1981	%/annum turnover (average)	%/annum growth (average)
Engineer	11	13	13	13	13	13	25%	4%
Attorney	0	1	1	1	1	1	n/a	20%
Meteorologist	1	1	1	1	1	1	n/a	0
Scientist	4	5	5	5	5	5	n/a	5%
Technician	7	9	9	9	9	9	40%	6%
Other	3	3	3	3	3	3	n/a	0
TOTAL	26	32	32	32	32	32		5%

It should be noted that the 20% increase in the attorney category represents a growth of zero to one attorney. As pointed out above, attorney time is purchased from the Office of the Attorney General. Staffing growth is limited by a lack of sufficient state funding. The high turnover rates for engineers and technicians are caused mostly by salaries being uncompetitive with those offered by the private sector.

In the local air pollution control programs, there is expected to be a ten percent per annum growth in all positions. Currently there are 17 professional and technical persons involved in these programs. By 1982 there will be approximately 28 persons in the positions of engineer, attorney, chemist, technician and sanitarian.

The enabling legislation provides for the continuation of the program of the Bureau of Vehicular Emissions Inspection only until 1980, and new legislation will be proposed in 1978 to continue the program

beyond the expiration date. The following workforce projections are based on the assumption that the program will be renewed after 1980. The bureau has 24 authorized professional and technical positions. All of these positions are currently filled. The following table depicts workforce projections for the bureau.

TABLE V

ARIZONA DEPARTMENT OF HEALTH SERVICES

Bureau of Vehicular Emissions Inspection
Workforce Projections to 1982 (est.)

Position	1976	1977	1978	1979	1980	1981	%/annum turnover (average)	%/annum growth (average)
Engineer	4	4	4	4	4	4	n/a	0
Technician	11	11	11	11	11	11	9%	0
Other	9	9	9	9	9	9	n/a	0
TOTAL	24	24	24	24	24	24		0

No workforce growth is anticipated over the next five years. Because of the relative youth of the program, turnover rates are difficult to predict at this time. To date, there has been a loss of only one technician.

Workforce projections regarding the private sector were obtained through on-site and telephone interviews with public and private sector professionals engaged in air pollution control activities in Arizona. These sources were asked to provide their best professional estimate of workforce projections for air pollution control.

The workforce in the private sector is expected to grow at a rate of approximately 10 percent per annum and growth will be the result mainly of an increased workload occasioned by more stringent air pollution regulations. Most companies developed their environmental staffs in the early 1970s, and most are now in compliance with current air pollution standards. Of the 394 principal installations, 371 are in compliance with emissions limits or compliance schedules. Companies which are experiencing compliance problems or require short-term assistance often will hire an outside consultant rather than increase their own staff. Sources in the field indicate that out-of-state consultants are often utilized for this purpose.

The following table illustrates estimated growth to 1982 for professional and technical positions. Professional positions include degreed engineers, chemists, and meteorologists. Although an increase in the number of attorneys is expected, not enough information is available for projections to be made. Technical positions include technicians with either an associates degree or on-the-job training. Numbers represent persons working both full-time and part-time in air pollution control, and thus the table may tend to overestimate workforce levels.

TABLE VI

STATE OF ARIZONA

Private Sector Professional and Technical Fields
Workforce Projections to 1982 (est.)

Position	1976	1977	1978	1979	1980	1981	%/annum growth (average)
Professional	35	39	43	47	52	57	10%
Technical	35	39	43	47	52	57	10%
TOTAL	70	78	86	94	104	114	10%

The preceding table indicates that workforce growth in the private sector will be quite low over the next five years, with a total numerical increase of approximately 44 positions. Specific turnover rates are not available. However, private sector sources report that turnover rates for both professional and technical positions are low.

Sources at the Department of Health Services do not expect any change in the numbers of emissions inspectors over the next five years.

Although there will be some growth in the workforce in both the public and private sectors, it will not exceed 10 percent in either sector of the economy. The state and local air pollution control programs and vehicular emissions control program will experience an increase of approximately 37 professional and technical personnel over the next five years, while the private sector is expected to increase by approximately 44 positions. It appears that professional and technical positions will increase at approximately the same rate.

D. Training and Certification

The Bureau of Air Quality Control conducts quarterly smoke schools for smoke readers, who must be recertified every six months. Between 20 and 25 people attend each session. They represent the bureau, local air pollution control programs, and industry. Every other session of the smoke school covers not only smoke reading training but also provides legal, meteorological, and other technical instruction. Bureau sources indicate that they would like to shift the responsibility for this training to educational institutions because of the large amount of time and resources required of the bureau to continue the program. The bureau

also tries to conduct an annual stack testing seminar of approximately one week in length. The seminar includes both theory and field work and is directed toward engineers who will be involved in stack testing operations. Between 12 and 20 persons attend each seminar.

The Bureau of Vehicular Emissions Inspection is also active in training. This Bureau holds seminars for the automotive repair industry. Three such seminars have been held this year, and approximately 100 persons have attended. Bureau officials point out that the repair industry has little motivation to acquire this training which covers automotive tune-up procedures and vehicular emissions control. Two workshops of two days duration were also held this year on tune-up procedures and emissions control for high school and vocational/technical school auto mechanics instructors and the general public. Approximately 25 people attended each workshop funded by a grant from EPA. The Bureau also maintains liaison with the automotive repair industry to ensure its understanding of the emissions inspection/maintenance program and to provide information on low emissions tune-up procedures.

Bureau of Vehicular Emissions Inspection sources assert that many automotive mechanics lack the skill to or simply do not tune-up vehicles in a manner which will allow emission control systems to operate most efficiently. Bureau sources also point out that only the automobile industry can pressure dealers into ensuring that their mechanics release vehicles in a proper state of tune. Many vehicle owners prefer improperly operating emission control systems because they believe falsely that they afford greater speed and improved gas mileage. However, as suggested above, many auto mechanics do not know how to properly

perform a low emissions tune-up. As a result, sources at the bureau urge modification of vocational education programs in auto mechanics, particularly in the area of low emissions tune-up procedures. Moreover, this situation suggests that there is a need for further training of persons who already are working as auto mechanics.

Public and private sector sources are aware of no comprehensive university or vocational/technical programs designed to train air pollution control professionals or technicians.

E. Career Potential

Little workforce growth is likely to occur over the next five years in air pollution control in the public and private sectors. Accordingly, career opportunities will be limited. There is a need for highly trained engineers and scientists to design properly operating equipment, especially precipitators, for private industry. However, although more work is needed in equipment design, industry may not allocate sufficient money to this area. It may be that more stringent air pollution standards will lead to increased activity in equipment design. A criticism of currently utilized equipment is that it was designed without sufficient attention to the environment in which it must operate.

Technicians skilled in mechanics and electronics are also utilized both in government and in industry but, again, limited workforce growth will tend to restrict career opportunities in this area.

Sources in the field indicate that they are aware of no unique or new careers emerging in the air pollution control field.

F. Conclusion

The air pollution control field is currently staffed by engineers, chemists, meteorologists, technicians, attorneys, and data processing personnel. There are expected to be few workforce opportunities in the public sector because of insufficient funding. The private sector appears to be well staffed and will experience additional growth as a result of more stringent air pollution standards. This growth, however, is also expected to be quite limited. Field research suggests that fewer than 100 professionally and technically trained people will find job opportunities in the air pollution control field in the next five years.

Public and private sector sources have identified several areas in which additional training is needed for persons entering or already working in the field. First, training is needed for auto mechanics in the proper adjustment of emission control systems. Second, both professional and technical employees require an upgrading of communication and writing skills. Finally, environmental engineers and scientists require additional environmental law background, as well as constant upgrading in this area. It may be that vocational/technical institutions can assume some of the responsibility for providing the necessary training, perhaps through continuing education programs and short courses. EPA may also be able to provide some of this training either through courses offered at convenient locations or through the development of self-instructional audio-visual packages.

II. NOISE

A. Introduction

Arizona has no noise legislation at the state level. For the past two years, the Arizona Department of Health Services has attempted to obtain legislative approval to allow the Department to have regulatory responsibility for noise control and to establish noise standards. However, the proposed legislation has been defeated. Sources in the field anticipate that noise legislation eventually will be passed by the State Legislature but that this may not occur for about five years.

B. Workforce Profile

Data for the workforce profile were obtained through on-site and telephone interviews with professionals in the field. The Arizona Department of Transportation, Highways Division, Environmental Planning Services, appears to be the only state agency currently involved in noise control. Here a staff of two civil engineers conduct noise studies for all highway construction projects as required by the Federal Highway Administration Policy Memorandum, Volume 7, Chapter 7, Section 3. One of the engineers devotes full-time to noise studies, while the other engineer devotes half-time.

Four cities in Arizona have municipal noise control ordinances. They are Flagstaff, Phoenix, Tempe, and Tucson. These ordinances are shown in the following table which is adapted from Sound and Vibration, December, 1975.

TABLE VII

STATE OF ARIZONA

Municipal Noise Ordinances (1975)

City	Nuisance	Zoning	Vehicle	Rec/ Vehicle	Rail-Road	Aircraft	Construction	Building
Flagstaff	0	-	0	-	-	-	-	-
Phoenix	0	-	0	0	-	-	-	-
Tempe	X	X	X	-	-	X	-	-
Tucson	X	X	-	-	-	-	-	-

KEY: X Regulations including acoustical criteria
0 Regulations not including acoustical criteria
- No regulations

The ordinances are enforced by local law enforcement authorities in response to complaints. The omission of acoustical criteria in the ordinances means that the regulations are nonquantitative and therefore difficult to enforce.

In addition, various engineering and architectural firms, as well as university professors occasionally work as consultants in the field of noise control. However, sources in the field cannot provide estimates of the number of persons engaged in consulting on noise control projects.

C. Workforce Projections

Department of Transportation sources expect no change in their staffing level in the next five years. If the State Legislature does pass state noise legislation, the Department of Health Services will devote some of its staff to noise control. It is premature, though, to make workforce projections for this department. Because environmental noise pollution control has not developed as a distinct professional area and because there is currently little interest in this

field, the workforce in the private sector is expected to increase only minimally over the next five years.

D. Training and Certification

The engineering departments of the three state universities, University of Arizona, Arizona State University, and Northern Arizona University, provide some courses in noise and conduct occasional noise research. It appears that no vocational/technical institutions offer any noise control instruction that leads to a degree or certification.

E. Career Potential

Since the workforce in the area of noise pollution control is limited, there is little evidence that a significant number of career opportunities will develop over the next five years. Environmental engineers in both industry and the public sector may be assigned noise control duties. However, it is unlikely that distinct careers in noise control will be developing.

F. Conclusion

At the present time there is a definite lack of activity in environmental noise control in Arizona. If public awareness or national policy does force the development of environmental noise control regulations either on the federal or state level, there may be a need for trained scientists, engineers, planners, systems analysts, attorneys, and administrators, as well as for technicians. If development in this field should occur, upgrade/enrichment programs may be necessary

for all involved personnel of all professions, and program development may be required, in particular for training in less than degreed technical areas where no training programs currently exist.

III. PESTICIDES

A. Introduction

The Pesticide Use and Application Act, revised in 1974, is Arizona's primary pesticide law. It provides for the certification of private and commercial applicators and their equipment and agricultural pest control advisors as required by the Arizona statutes. Agricultural pest control advisors are persons who, as part of their employment, offer any recommendations to a grower or any public or private agency concerning the control of any specific agricultural pest condition or who hold themselves forth as an authority or general advisor on any agricultural pest to a grower.

The Board of Pesticide Control is the lead agency in the certification program. The board is composed of the chairman of the Commission of Agriculture and Horticulture and twelve members appointed by the Governor. Members include one entomologist in the public service, six persons engaged in agriculture, one person engaged in the agricultural chemicals industry, one person engaged in the business of pesticide application, and three representatives of the general public. The board is empowered to make and enforce all rules and regulations regarding the sale and use of agricultural pesticides. Its basic function is licensing commercial applicators and their equipment and agricultural pest control advisors. It is also responsible for issuing annual permits to sellers and growers who use pesticides for agriculture. This Board does not certify and regulate structural commercial applicators.

The Structural Pest Control Board is responsible for regulation and certification of structural commercial applicators. These activities

are monitored by the Board of Pesticide Control. The Structural Pest Control Board was established by the Structural Pest Control Law of 1965 and is a five-member board composed of two members from the general public and three members with five or more years experience in the structural pest control area.

B. Workforce Profile

The Board of Pesticide Control has four professional staff members to carry out the certification and field inspection program. Staff members include one administrator, two inspectors, and one accountant. The administrator is a degreed entomologist and chemist and the inspectors are experienced in the use of agricultural chemicals. The administrator is a member of the Board of Pesticide Control. The Structural Pest Control Board has a staff of two professionals, one administrator and one inspector who is experienced in the use of agricultural chemicals. The administrator is a member of the Structural Pest Control Board.

The Arizona state laboratory, the Bureau of Epidemiology and Laboratory Services, employs two chemists and one laboratory technician in its Pesticide Unit. The Department of Health Services, Bureau of Sanitation also is involved in pesticide usage and pest control. As a health agency its authority and participation is in the area of health effects and as such is interested in accidents, overspray, spillage, and misapplication. The Bureau has contracted a study on the problem of pesticide container disposal and is now in the process of trying to arrange, through contractors, for designated sites at which containers can be crushed and buried. In addition, two CETA employees are working on vector identification.

Funding for those two positions will probably continue through 1977. Four persons from the Department of Health Services are engaged in pesticide and pest control activities on either a full-or part-time basis. These staff members have backgrounds in entomology, biology, and botany.

Approximately seven county health departments conduct vector control programs and often apply pesticides. An estimated 80 persons participate in the application of pesticides by these departments.

The University of Arizona Cooperative Extension Service is responsible for the training of commercial and private applicators and pesticide advisors. The Extension employs a pesticide coordinator who provides liaison between the state pesticide boards, the Department of Health Services, and USDA. The Extension also employs a communications specialist who produces a pesticide newsletter that is distributed throughout the state and a training specialist. In addition, approximately 20 faculty members from other programs participate in applicator and advicor training.

The Commission of Agriculture and Horticulture has approximately 30 certified pesticide advisors on its staff. They have backgrounds in plant pathology, entomology, and biology. They are involved in inspection of nurseries and apiaries and laboratory work in insect control, as well as in advising on proper pesticide usage.

The Board of Pesticide Control and the Structural Pest Control Board estimate that there are approximately 2,805 commercial applicators and 1,000 private applicators in the state who may need certification to achieve the requirements of federal and state legislation. These two boards have estimated that the commercial applicators will be certified

in the following categories in these numbers:

Agricultural Pest Control	100
Forest Pest Control	25
Ornamental and Turf Pest Control	1550
Seed Treatment	40
Aquatic Pest Control	150
Right-of-Way Pest Control	30
Industrial, Institutional, Structural and Health Related Pest Control	860
Public Health Pest Control	50
TOTAL	2,805

The total estimated pest control picture is reflected by the following table in which figures are approximations of the workforce engaged in pesticides on either a full- or part-time basis.

TABLE VIII

STATE OF ARIZONA

Board of Pesticide Control
Current (1976) Staffing Level
Public and Private Sectors

Public Sector		1976
Board of Pesticide Control		4
Structural Pest Control Board		2
Department of Health		4
State Laboratory		3
State Extension		22
County Health Departments		80
Commission of Agriculture & Horticulture		30
	TOTAL	145
Private Sector		
Farmers		4,000
Owners/Operators/Applicators		2,805
	TOTAL	6,805

It should be noted that although there are approximately 4,000 farmers in Arizona, an estimated 1,000 of them will be certified to use restricted use pesticides. Thus, an estimated 4,000 persons in the

public and private sectors are involved in the field of pest control. Augmenting this figure are approximately 550 licensed pest control advisors, many of whom are sales representatives for pesticide dealers and distributors, technical representatives for private manufacturers, and private consultants. Note that some of the workforce listed in Table I are also licensed advisors.

In addition to the pesticides workforce described above, the Commission of Agriculture and Horticulture maintains inspectors at its 11 border stations. One of the inspectors' functions is to prevent the introduction into Arizona of harmful pests from other states and countries.

C. Workforce Projections

Information concerning workforce projections was collected through on-site and telephone interviews with pesticide professionals in the field. Board of Pesticide Control and Structural Pesticide Control Board sources each expect to acquire three more field inspectors in the next five years as a result of FIFRA requirements. Degreed agricultural scientists will be sought, particularly entomologists, and those persons with a knowledge of the pesticide industry will be preferred. None of the other state agencies discussed in the previous section expects an increase in staffing in pest control with the exception of the Commission of Agriculture and Horticulture. Sources at the Commission indicate that some staffing growth will occur as a result of FIFRA. However, they could provide no estimates concerning the magnitude of expected growth. The Department of Health Services will experience a decline of two

persons in this area after 1977 if the CETA positions are discontinued as expected.

Sources in the field suggest that growth in the number of commercial applicators will be no more than five percent per year. Presently, the workforce in the field is sufficient and not much increase is expected in the demand for the services of commercial applicators. Also said to restrict growth is the stringency of the FIFRA requirements. If the growth rate is five percent per annum and if there are currently 2,805 commercial applicators, by 1982 there will be 3,579 commercial applicators. This growth rate would yield an overall increase of 774 commercial applicators in five years.

Turnover rates in the public sector are relatively low, approximately ten percent per year. The annual turnover rates among the labor crews of commercial applicators is reportedly high, approximately 30 percent. This high turnover rate results from the seasonal nature of the job and the comparatively low pay.

D. Training and Certification

The Board of Pesticide Control and the Structural Pest Control Board have effected a working relationship with the University of Arizona's Cooperative Extension Service in support of applicator and pest control advisor training programs. The Extension Service has trained 1,400 agricultural and structural commercial applicators and over 500 pest control advisors. These persons receive 24 hours of training either through short courses or 13-week sessions. Plans are being made to train private applicators who require certification. The Extension Service will cooperate with the Department of Health

Services in the training of 80 county health department personnel who apply pesticides. This training will be conducted in February, 1977. The University of Arizona also offers pesticides courses on the undergraduate level in the College of Agriculture.

E. Career Potential

Because the number of commercial applicators is expected to increase by more than 100 per year, career opportunities appear to exist in this field. Jobs on applicator crews are continually available because of the high rate of employee turnover. However, because of the seasonal nature of the job, the low pay, and lack of opportunities for advancement, such jobs do not offer particularly desirable long-term career choices. Career opportunities are expected to develop in the area of integrated pest management, on the professional level for consultants and on the technical level for field scouts. Not enough information is available at the present time to predict the magnitude of demand over the next five years for personnel trained in integrated pest management. Since public sector growth will be low, few career opportunities exist there. Although the need exists for research and for people with expertise in the area of pesticide container disposal and disposal of surplus pesticides, adequate funding may not be available for this purpose either in the state government or the universities. The opportunities that do exist in the public sector are for field inspectors. These positions require a background in agricultural science and a knowledge of the pesticide industry.

F. Conclusion

While employment opportunities in the public sector are limited, some growth can be expected among commercial applicators. The rate of growth may be five percent per year. In addition, careers in the area of integrated pest management may develop as federal and state regulations become more stringent and as more integrated pest management research becomes available. Consequently, the demand for trained personnel can be expected to develop, and both universities and vocational/technical institutions may find a market for graduates trained in integrated pest management. Currently, the certification courses offered by the University of Arizona Extension Service includes a unit on integrated pest management techniques.

There is a need for continual upgrading of people in the field as legislation and technology changes. This need is being met insofar as possible by the Extension Service. Disposal of pesticide containers and obsolete and surplus pesticides has been a problem for Arizona and additional work is necessary in this area.

IV. POTABLE WATER

A. Introduction

There are 1,800 potable water systems in Arizona, approximately 40 of which are municipal systems. Water treatment facilities and water distribution systems are classified according to population or population equivalent served and/or type of treatment carried out. The chief operator or superintendent in direct charge of a treatment plant is required to be certified at the grade of the plant. Shift foremen or other operators in charge of the plant in the absence of the chief operator or superintendent are required to be certified at one grade lower. Grade IV is the highest classification and Grade I is the lowest. The grades of certification are ranked so that a person holding certification in a particular grade is permitted to operate all facilities in that particular grade and any lower grade.

Fifty of the water facilities serve a comparatively large number of people and have a diversified staffing complement which includes a superintendent, shift operators, maintenance, and administrative personnel. The remaining plants are small, many of them having just one certified operator.

While shortages of drinking water have occurred in outlying areas, water supplies are generally adequate, and no radical changes in their availability appear to be imminent. Sources in the field suggest that current treatment in the state is also adequate, particularly in the larger cities. Some rural treatment is not as good, and the frequency of sampling is being increased in these areas. Most of the state's

drinking water comes from ground water supplies, a source which provides fewer problems than surface water supplies.

The state is currently investigating or subcontracting for investigation the following topics: determination of the extent of a nitrate problem in the sources of drinking water in Arizona and the practical costs of treatment, determination of practical costs for defluoridation of water supplies, and the analysis and evaluation of Arizona's drinking water bacteria sampling program including recommendations regarding improvement.

The Arizona Department of Health Services (ADHS), Bureau of Water Quality Control (BWQC) has regulatory responsibility for both the potable and waste water programs. With regard to the water supply program, BWQC is currently working in conjunction with personnel from the State Attorney General's office to review and revise state legislation and drinking water regulations for the acceptance of primary responsibility for the Safe Drinking Water Act. A development grant has been provided by EPA to develop a six-year program plan and budget for developing the State Public Water Supervision Program, the program of compliance with the Safe Drinking Water Act. Development of the program plan and budget is being carried out by a subcontractor to ADHS.

B. Workforce Profile

Information for the workforce profile was obtained through on-site and telephone interviews with personnel from the Department of Health Services, Bureau of Water Quality Control and the state health laboratory. Of particular assistance in the collection and compilation

of this data were Mr. Edmund C. Garthe, Mrs. Mildred Matters, Dr. Ronald Miller, and Dr. Jon Counts, all of ADHS.

As the regulatory body for the water supply program, BWQC is responsible for the following major functions:

1) Review of plans and specifications for construction or modification of water facilities to ensure that the plans comply with department regulations;

2) Monitoring of water quality in potable supplies to determine that it is safe for human consumption: surface and ground water quality is monitored to develop trends and detect contamination;

3) Routine inspection of water supply treatment facilities on a 12 to 18 month frequency to determine if operation and maintenance meet acceptable standards. Facilities with difficulties are issued compliance schedules and are inspected at appropriate milestones in the schedule;

4) Training and certification of water treatment plant operators;

5) Development of capability for assumption of primary enforcement responsibility for the Safe Drinking Water Act.

The water supply program of BWQC is carried out through its headquarters in Phoenix and three field offices: the Northern Regional Office in Flagstaff, the Southern Regional Office in Tucson, and the Central Regional Office in Phoenix. A total of 15 professional and technical personnel are involved in the water supply program, with the position of engineer predominating the program. The distribution of staff among existing positions is shown in the following table:

TABLE IX

ARIZONA DEPARTMENT OF HEALTH SERVICES

Bureau of Water Quality Control
Water Supply Program Personnel
Current (1976) Staffing Level

Position	1976
Engineer	9
Chemist	1
Sanitarian	1
Other	4
TOTAL	15

The engineers hold the position of public health engineer or public health engineering assistant. Approximately half are registered professional engineers and half are degreed but not registered. Degrees include chemical, sanitary, mechanical, and civil engineering. The chemist is degreed and devotes half-time to the water supply program. The 'other' category includes two administrators who are registered professional engineers, a systems analyst, and a training specialist who devotes half-time to the water supply program.

Six of the engineering positions, the systems analyst position, and an administrative position were funded by an EPA grant, Public Water System Supervision State Program Grant, and filled in 1976. The function of this additional staff is to initiate and carry out the program to allow the state to assume primary enforcement responsibility for the Safe Drinking Water Act.

The following table illustrates the distribution of certified treatment plant operators by operator classification:

TABLE X

STATE OF ARIZONA

Current (1976) Certified Water Treatment System Operators (est.)

Classification	1976
I	200
II	405
III	100
IV	40
TOTAL	745

It should be pointed out that although the actual total of active certified treatment plant operators is 745, the distribution of certified operators among the four classifications is an estimate made by BWQC personnel. Grade IV is the highest classification and Grade I the lowest. Persons holding certification may operate systems in the particular grade for which they are certified and any lower grade of system.

Certification of distribution system personnel also is mandatory. However, complete workforce data in this regard are not available. ADHS sources estimate that there are approximately five certified distribution system operators in Phoenix and approximately 20 in Tucson. In addition, there are an estimated 100 additional persons in these two cities involved in labor and maintenance who are not certified operators.

Bacteriological monitoring of water supply samples is carried out by the three ADHS laboratories in Phoenix, Tucson, and Flagstaff, one county laboratory, and one private laboratory. All chemical monitoring is done at the state laboratory in Phoenix. Sources at ADHS estimate that a total of six degreed chemists and six laboratory technicians participate in bacteriological and chemical monitoring. Laboratory testing is also performed by treatment plant operators and their assistants.

In total, there are approximately 1,000 persons in the State of Arizona working the field of water supply in the public and private sectors.

C. Workforce Projections

Workforce projections are based on the best professional judgement of personnel at ADHS. Information was obtained through on-site and telephone interviews. The persons mentioned in the previous section were, again, extremely helpful in providing future workforce trends and estimates.

Eight new professional positions were authorized in the past year for carrying out the provisions for accepting primacy under the Safe Drinking Water Act. Although ADHS officials indicate that the BWQC has a need for a doubling of staff to effectively carry out its functions, no further positions are expected to be authorized in the next five years because of legislative unwillingness to increase the state government workforce.

TABLE XI

ARIZONA DEPARTMENT OF HEALTH SERVICES

Bureau of Water Quality Control
Water Supply Program Personnel
Workforce Projections to 1982 (est.)

Position	1976	1977	1978	1979	1980	1981	%/annum turnover (average)	%/annum growth (average)
Engineer	9	9	9	9	9	9	11%	0
Chemist	1	1	1	1	1	1	n/a	0
Sanitarian	1	1	1	1	1	1	n/a	0
Other	4	4	4	4	4	4	n/a	0
TOTAL	15	15	15	15	15	15		0

The turnover rate of 11% per annum for engineers represents the loss of approximately one engineer per year. This turnover rate may increase over the next several years as some entry level engineers gain experience and find jobs in the private sector where salaries are higher. The only new hiring for potable water program operations in BWQC will be to replace those personnel lost through employee turnover.

ADHS sources indicate that more stringent enforcement of existing state regulations combined with the requirements of the Safe Drinking Water Act will necessitate an increase in the number of certified treatment plant operators over the next five years. Specifically, the number of certified operators in each category is expected to double by 1981. If it is assumed that growth will occur at a constant rate over the next five years, workforce projections for certified treatment plant operators are as follows:

TABLE XII

STATE OF ARIZONA

Water Treatment Plant Operators
*Workforce Projections to 1982 (est.)

Classification	1976	1977	1978	1979	1980	1981	%/annum turnover (average)	%/annum growth (average)
I	200	240	280	320	360	400	n/a	15%
II	405	486	567	648	729	810	n/a	15%
III	100	120	140	160	180	200	n/a	15%
IV	40	48	56	64	72	80	n/a	15%
TOTAL	745	894	1,043	1,192	1,341	1,490		15%

*This table includes estimates of both new entry and upgrades.

The projected per annum growth rate for the next five years, then, is 15%. Although specific turnover rates are not available for each classification of operator, turnover is reported to be extremely high,

approximately 30% per year. The high rate of turnover is caused primarily by low salaries. ADHS officials anticipate that higher standards and more rigorous enforcement will be accompanied by increased training and thus higher salaries for certified operators. Higher salaries, in turn, are expected to contribute to a lowering of the turnover rate. However, salary decisions for operational personnel rest with the municipalities and owners of private systems.

Although the assumption of primary enforcement responsibility for the Safe Drinking Water Act would not increase the number of systems regulated in Arizona, primacy would require an increase in sampling activities. Therefore, the number of laboratory personnel involved in bacteriological and chemical sampling is expected to increase. In addition, a program of voluntary certification of private laboratories has been initiated by the Bureau of Epidemiology and Laboratory Services. Statutory authority for mandatory certification may be obtained. If so, some sampling activities may be shifted to private laboratories. At this time, ADHS officials do not know the number of private laboratories this would involve, nor can they estimate the probable increase in the number of laboratory personnel working in the area of drinking water over the next five years.

Not only will the assumption of primary enforcement responsibility for the Safe Drinking Water Act necessitate an increase in sampling, but it also will require an increase in monitoring and inspection of facilities. ADHS officials have not yet determined whether or not this workload can be handled by existing BWQC staff. If existing staff is insufficient, county health departments will be expected to provide personnel to conduct monitoring, inspections, and possibly water sampling and analysis.

In summary, ADHS sources expect no further growth in the state potable water program because of restricted funding at the state level. A 15% per annum increase in the number of certified treatment plant operators is projected for the next five years. This translates into a growth of approximately 150 persons per year. Although specific workforce profile and projections cannot be made for treatment plant positions other than certified operator, ADHS officials indicate that growth will occur in administrative, labor, and maintenance positions. Finally, enforcement of the Safe Drinking Water Act is likely to lead to an increase in the number of jobs for chemists and laboratory technicians. Again, the magnitude of growth cannot be predicted at this time.

D. Training and Certification

BWQC employs a training specialist who works half-time in water supply. Training activities are conducted in cooperation with community colleges throughout the state. In five areas of the state, introductory semester courses in water treatment are offered on a regular basis. Throughout the rest of the state, training is provided in accordance with needs as identified by ADHS. Treatment plant operators, as well as personnel involved in other aspects of water supply, attend these training sessions. In fiscal year 1975, 350 people attended introductory water and waste water classes at community colleges; however, no breakout is available of persons attending only the water course.

Several training needs have been identified by ADHS officials. First, while introductory semester courses in operations are now available in most areas of the state, no instruction is offered in either maintenance or in laboratory skills. Second, no intermediate or advanced operator

semester courses have been available except in Phoenix. Third, the overwhelming majority of the certified operators in the state are employed in the larger cities and towns and the only ongoing training program before 1973 was in Phoenix. ADHS has therefore placed its major effort on providing training for the more remote areas of the state. Fourth, a serious need exists for instructor training.

In response to these needs, EPA has granted ADHS with funding for the development of a one-year community college curriculum. The project has been subcontracted to Pima Community College District which will develop a curriculum for a one-year certified waste water treatment plant operator training program which can be implemented in any community college in the state desiring such a program. In addition to the one-year program, a training center is being built to be affiliated with Pima Community College. This facility will offer hands-on short courses, workshops for instructors, and regional seminars to meet training needs as they arise. After the waste water treatment plant operator program has gotten underway, ADHS officials will attempt to obtain funding for the development of a second year to the program which will provide instruction in waterworks and public works operation and management. Graduates of the two-year program will be awarded an Associate of Applied Science degree. Regional workshops and instructor training are expected to supplement this curriculum, also.

E. Career Potential

Since there is no growth expected in the workforce employed in the state program, career opportunities here will be limited. Only turnover will be replaced, and turnover is likely to remain quite

low. There will be some opportunities for chemists and laboratory technicians because of the increased bacteriological and chemical sampling required by the Safe Drinking Water Act. If certification of private laboratories becomes mandatory, these facilities may assume some of the activities currently conducted by the state, and accordingly may increase their staffs of chemists and laboratory technicians. However, the magnitude of increase in demand for such personnel cannot be predicted at this time.

Because of more stringent enforcement of existing regulations and more stringent legislation, water treatment plants will require an increase in the number of certified operators over the next five years. Specifically, a 15% annual increase is expected for each category of operator. This means that approximately 150 new operators will be hired each year for the next five years. Not only are jobs in water treatment plant operations expected to increase, but also, career opportunities in maintenance, management, and labor in public works departments are expected to be available. ADHS anticipates that training needs for these positions will be met through community college semester and short courses, a two-year waste water, potable water, and public works curriculum, and regional workshops.

F. Conclusion

The foregoing suggests that the area of greatest workforce need is in water treatment operations, labor, maintenance and administration. This is the result of more stringent legislation, more strict enforcement of existing regulations, new treatment methods, and changing technologies.

Although ADHS indicates that a doubling of water supply staff is necessary to adequately carry out the drinking water program, no further staff growth is expected to be forthcoming in the next five years. In the past year this program experienced a staffing growth of eight professional and three clerical positions to provide support for acceptance of primary enforcement responsiblity for the Safe Drinking Water Act.

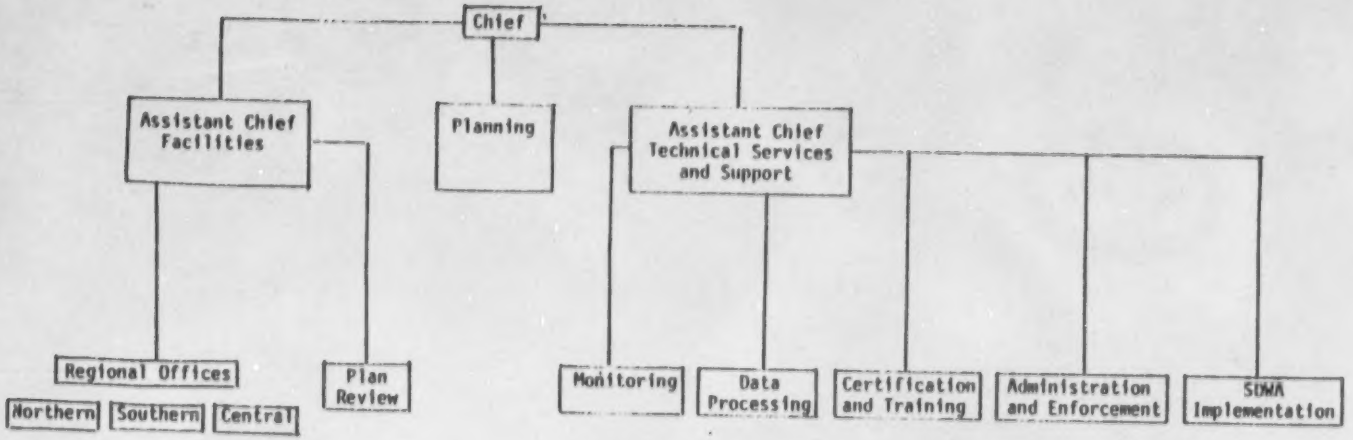
According to ADHS sources, operator training is in serious need of upgrade because of a past insufficiency of training as well as the development of new treatment methods and technologies. Certification requirements may become more rigorous so that treatment plants can obtain more highly qualified operators. To improve water treatment plant operator training, ADHS anticipates obtaining EPA funding to develop a community college waterworks/public works curriculum. So far, however, funding has been requested only for the development of a community college waste water treatment plant operator training program, and it will be several years before a training program in waterworks can be developed and implemented.

ARIZONA DEPARTMENT OF HEALTH SERVICES

BUREAU OF WATER QUALITY CONTROL
(Waste Water and Water Supply)

ORGANIZATION CHART

Figure 3



V. RADIATION

A. Introduction

Regulatory responsibility for radiation is vested in the Arizona Atomic Energy Commission (AAEC). The Commission is comprised of 12 members. The executive director of the Office of Economic Planning and Development and the director of the Arizona Department of Health Services are statutory commissioners. The other ten members are appointed by the governor from among persons possessing at least four years of education or experience in the use or control of atomic energy/radiation. The statutory policy of the Commission is defined in the enabling legislation as follows: "to encourage fully the constructive development and uses of atomic energy and radiation and their sources consistent with the health and safety of workers and the public and consistent with powers and responsibilities of the Federal government and other state governments".

As a regulatory agency, AAEC is responsible for direct regulation and control of all sources of radiation, both ionizing and non-ionizing, within the state. AAEC carries out the regulatory program for dental/medical and industrial X-ray and for environmental radiation surveillance. AAEC evaluates nuclear technologies which might be of benefit to Arizona and disseminates information on nuclear technologies to the Governor, legislature, other state and local agencies, and to the public. In addition, the director serves on the Arizona Power Plant and Transmission Line Siting Committee and represents the state on the Western Interstate Nuclear Board. Arizona is an NRC agreement state.

B. Workforce Profile

Data for the workforce profile and projections was collected through on-site and telephone interviews with sources in the field. Of particular assistance was Mr. Donald C. Gilbert, Executive Director, AAEC.

AAEC has a professional and technical staff of 10 to carry out the activities described above. The staffing of AAEC, by position, is shown in the following table:

TABLE XIII

ARIZONA ATOMIC ENERGY COMMISSION

Current (1976) Staffing Level

Position	1976
Physicist	4
Technician	3
Other	3
TOTAL	10

The physicists are degreed and certified health physicists. The technicians hold the position of radiation control technologist and are registered technologists with training in X-ray and medical technology. The 'other' category consists of the executive director of AAEC, a public information officer, and an accountant.

Comprehensive information regarding private sector workforce figures are not available. However, according to estimates provided by ERDA publication #78 entitled An Analysis of Nuclear Related Technician Manpower in the Western States, there were 13 radiation control technicians working in Arizona in 1975. A radiation control technician is defined in the ERDA study as one who monitors personnel, plant facilities,

work environment, and plant vicinity to detect and control radioactivity and/or radiation exposure and performs operation, analysis, and calibration of radiation monitoring equipment.

C. Workforce Projections

Sources in the field indicate that there will be a net increase in the workforce employed in radiation protection by the early 1980s. The majority of growth will be the result of the construction of three nuclear generating stations by the Arizona Nuclear Power Project (ANPP). Plans call for the installation of three 1,270 megawatt nuclear units. The facility has been named the Palo Verde Nuclear Generating Station. The first unit is planned for commercial operation in May, 1982, with the second and third units to become operational at subsequent two-year intervals.

Growth of AAEC will be the result of a workload increase caused by the operation of these plants and by economic growth in Arizona. Workforce projections are as follows:

TABLE XIV

ARIZONA ATOMIC ENERGY COMMISSION

Workforce Projections to 1982 (est.)

Position	1976	1977	1978	1979	1980	1981	%/annum turnover (average)	%/annum increase (average)
Physicist	4	4	4	4	6	7	n/a	13%
Chemist	0	0	0	1	1	1	n/a	20%
Technician	3	3	3	4	4	4	n/a	7%
Other	3	3	3	3	3	3	n/a	0
TOTAL	10	10	10	12	14	15		9%

Since the nuclear power plants will not be operational until the early 1980s, staffing growth for AAEC will not occur for several years. All physicists will be degreed health physicists, the chemist will be a degreed radiochemist, and the technician will be a radiation control technologist. AAEC will grow by an estimated total of five persons over the next five years. It should be noted that percentage increases for physicist and chemist positions appear quite large but actually represent the addition of only four positions.

The turnover rate for the professional and technical staff of AAEC is extremely low, only two persons having left in the past five years. AAEC sources indicate that this is because salaries are competitive with those of the private sector and that working conditions are good, that is, employees may become involved in a variety of different and challenging activities.

The previously cited ERDA publication reports that 11 additional radiation control technologists will be needed by 1977. Nine of these positions will represent growth, while the other two will represent the replacement of turnover. When the nuclear power plants become operational, operating personnel are expected to number about 300. Some of these persons will be involved in radiation protection, and all reactor operators, health physicists, the security force, plumbers, and maintenance personnel will require a working knowledge of radiation.

D. Training and Certification

AAEC employees continually participate in in-house cross-training, e.g., staff members share expertise with one another. In addition, staff members attend Nuclear Regulatory Commission courses.

AAEC also is active in providing education to the community. For five years AAEC operated a traveling van which went to public schools and civic clubs to offer information on emerging nuclear technology. The van is no longer in service because of the prohibitive cost, but AAEC staff members still make numerous presentations to communities.

Training for professional positions in radiation control is available through various Arizona universities. Training at the technician level is available through the community colleges.

E. Career Potential

New career opportunities will be developing in the early 1980s as a result of the construction of nuclear power generating units. According to ANPP, a workforce of approximately 300 persons will be hired for the operation of the power plants, with many of the positions requiring a working knowledge of various aspects of radiation. Sources in the field point out that there will be a need for nuclear welders, a job that requires specialized training and many years of welding experience. Overall, job opportunities can be expected to develop for highly trained engineers and health physicists as well as for technicians, maintenance and labor personnel.

F. Conclusion

Growth in the radiation protection field will result from the construction of three nuclear power plants, all of which should be operational by 1986. The AAEC expects its workload to increase by 400% by that time, although it expects a staffing growth of only 9% or 5 persons

by 1982. In the private sector, approximately 300 jobs will be created for the operation of the power plants, with some positions related to protection of the plant and external environment from radiation.

VI. SOLID WASTE

A. Introduction

In Arizona, almost all solid waste disposal is accomplished by land disposal methods. There are no municipal incinerators and industrial, commercial, and private incinerators have been limited by air pollution control regulations. Resource recovery operations in Arizona are also minimal. Since land is still plentiful and therefore relatively inexpensive in the state, suitable sites are available in or near most population centers, thereby making land disposal the most economical method of solid waste disposal.

Arizona has 144 approved landfills in operation throughout the state. Seventy-eight of these are classified as sanitary landfills, and 66 are substandard sites. No count has been made of the number of illegal "promiscuous" dumps throughout the state. The landfills which are approved are staffed by a workforce of approximately 160 persons.

The Arizona Department of Health Services, Division of Environmental Health Services, Bureau of Sanitation, Solid Waste Management Section has regulatory responsibility for Arizona's solid waste management program. Among the responsibilities of the Solid Waste Management Section (SWMS) are the following:

1) Enforcement of departmental rules and regulations;
2) Solid waste management program planning;
3) Assistance to communities on design of sanitary landfills;
4) Review of collection systems and training of sanitary landfill operators and collection personnel;
5) Conduct of studies into waste management problems and provision of recommendations on handling and disposal procedures;

6) Provision of recommendations on the handling and disposal of special wastes, in particular, hazardous wastes.

The first priority of SWMS pertains to the proper handling of hazardous wastes. Sources in the SWMS anticipate that a permit system will be developed for sites which handle hazardous wastes and that more intensive training of site operators will be conducted. The state will be required to meet the standards delineated by the Resource Conservation and Recovery Act of 1976. Interim regulations concerning hazardous waste management have been drafted and will be compared with the federal regulations when they are promulgated.

The second priority of SWMS is bringing land disposal facilities into full compliance with state regulations. This, however, is a slow process because of funding inadequacies and continual personnel changes in the municipalities operating landfills. Sources in the field report that there have been significant improvements in the practices of the smaller communities in the last several years. Many sites have changed from open dumps to improved landfill operations. Improvement has been accomplished through local efforts rather than through the infusion of money from the federal and state governments, but it still remains difficult for small communities to finance improvements in their land disposal operations.

B. Workforce Profile

Information for this section has been obtained through on-site and telephone interviews with personnel at the Bureau of Sanitation. Valuable assistance was provided by Mr. John H. Beck, Mr. Barry Abbott, and Mr. James T. Douthit.

The current staffing level of SWMS is two professional persons: one public health sanitarian and one public health engineering assistant. Two authorized positions for sanitarians are vacant. Because the pay is relatively low, these positions have been difficult to fill. SWMS intends to utilize the new positions to update its 1974 hazardous wastes report and to develop a comprehensive hazardous waste program.

Private sector workforce levels have been estimated by professionals at the Bureau of Sanitation. Estimates are based on data obtained directly from the two largest municipalities, the City of Phoenix and the City of Tucson and two county agencies, Maricopa County and Pima County. This data is supplemented by estimates based on field observation by Bureau staff for the rest of the state. Staffing levels, by positions, are listed in the table below:

TABLE XV

STATE OF ARIZONA

Solid Waste Private Sector
Current (1976) Staffing Level

Position	1976
Landfill Owner/Operator	144
Heavy Equipment Operator	99
Weighmaster	10
TOTAL	253

The number of landfill owner/operators is an estimate based on the fact that there are a total of 144 landfill sites in the state and that each of these landfills has at least an owner/operator. Phoenix, Tucson, and a few other cities operate weighing scales.

At the present time, few efforts are being made in Arizona toward resource recovery. Some cities have provided collection bins for paper, bottles, and cans that are sent for recycling. The only major governmental attempts at resource recovery were the Phoenix Composting Plant which operated for two years in the early 1960s before it failed, an experimental effort to utilize a hammermill at a Tucson landfill site, and, also in Tucson, an experimental effort to convert raw sewage to usable methane gas. Consequently, all resource recovery is carried out in the private sector and includes recycling of paper, rags, aluminum and steel cans, glass, steel, plastics, scrap metals, bark chips and sawdust, copper and iron mine tailings, citrus peel and pesticide containers.

A 1974 study prepared by the Bureau of Sanitation entitled, Resource Recovery in Arizona, indicates that at that time there were approximately 25 private firms engaged in resource recovery. However, this information has not been updated, and no workforce information is available concerning employment by the firms.

C. Workforce Projections

Workforce projection information, again, was provided by sources at the Bureau of Sanitation. It should be noted that these projections represent the best professional judgement of bureau personnel.

Because of more stringent enforcement of regulations and increased attention to the management of hazardous wastes, SWMS is expecting an increase in its professional staff over the next five years. Workforce projections for the section, by position, are shown in the following table:

TABLE XVI

ARIZONA DEPARTMENT OF HEALTH SERVICES

Solid Waste Management Section
Workforce Projections to 1982 (est.)

Position	1976	1977	1978	1979	1980	1981	%/annum turnover (average)	%/annum increase (average)
Engineer	1	1	1	1	1	1	n/a	0
Sanitarian	0	2	3	4	5	5	n/a	61%
Scientist	0	0	2	2	2	2	n/a	40%
Other	1	1	1	1	1	1	n/a	0
TOTAL	2	4	7	8	9	9		40%

The initial growth in sanitarians is based on the assumption that the two vacant sanitarian positions will be filled in 1977. The 'other' category refers to the section manager, who is a public health sanitarian. The scientist positions will be filled by a hydrologist and a chemist. It should be noted that although the percentage workforce increase appears to be quite high, percentages have been calculated from low numerical bases and, therefore, tend to over-represent the amount of future growth. A total of seven new positions is expected to be added to the SWMS over the next five years to expand the section's enforcement, technical assistance, and hazardous waste management activities.

Turnover rates are not included in the table because of the small numbers involved. SWMS sources indicate that engineers tend to stay in their jobs for two years and then are upgraded to other positions within the Department of Health Services. Fewer opportunities for up-grade are available for sanitarians, and they do not appear to find better opportunities in the private sector. Consequently, turnover rates for sanitarians are lower.

Private sector workforce projections were provided by Bureau of Sanitation staff and were obtained from the survey of four municipalities and field experience.

No up-to-date information concerning the workforce involved in collection is available. A 1971-1972 survey conducted by the Bureau of Sanitation of all communities with populations of 1,500 or more revealed that there were approximately 1,500 person-years devoted to collection of solid waste. Although there has been a steady increase in the amount of solid waste generated since the early 1970s, changes in the technology of collection are causing the traditional three-person crews to be decreased to one-person crews. Thus, over the next five years, the workforce in collection is expected to decrease.

Workforce projections, by position, for disposal are shown in the following table:

TABLE XVII

STATE OF ARIZONA

Private Sector Solid Waste
Workforce Projections to 1982 (est.)

Disposal	1976	1981	%/annum turnover (average)	%/annum growth (average)
Weighmaster	10	11	n/a	2%
Heavy Equipment Operator	99	111	n/a	2%
Foreman	9	11	n/a	4%
Spotter	23	27	n/a	3%
Other	19	23	n/a	4%
TOTAL	160	183		3%

Workforce growth in disposal, then, will be quite low, approximately 3% per year or an estimated 23 persons over the next five years. Although specific turnover rates could not be provided, available information

indicates that turnover is low for weighmasters and may be more than 20% for heavy equipment operators and spotters. The high turnover is the result of frequent injuries, low pay, and the unskilled nature of the jobs which allows little opportunity for advancement.

In summary, workforce projections for the solid waste field show that little growth is expected to occur over the next five years. The SWMS expects to experience an increase of approximately seven persons over the next five years, the workforce employed in solid waste collection will decrease as more capital intensive collection methods are introduced, and the workforce engaged in disposal is estimated to grow by approximately 23 persons over the next five years. Sources in the field are aware of no planned municipal resource recovery facilities. As pointed out above, the low cost of land disposal relative to resource recovery in Arizona makes the former method substantially more economical. The workforce growth that does occur in disposal will result primarily from more stringent enforcement of regulations and from increased attention to hazardous waste management.

D. Training and Certification

At the present time, the state is not involved in training of landfill personnel, although some of the cities have their own in-house training programs. Sources at the Bureau of Sanitation point out that the operators in the larger cities are fairly well-trained and competent and that efforts are needed to reach the operators in the smaller towns. The bureau is planning to develop a program for on-site training of operators but cannot yet finance such a program. Operators are in particular need of training

in the handling of hazardous wastes. If special hazardous waste disposal sites are established in Arizona, operators will need strong technical training.

E. Career Potential

In view of the limited amount of workforce increase projected to occur over the next five years, career potential can be expected to be quite limited. There will be some demand for heavy equipment operators who are skilled in machinery usage, proper landfill practices, and correct handling of hazardous wastes. Highly trained engineers, geologists, and hydrologists may also find career opportunities in the management of hazardous wastes in such areas as site selection and design and development of disposal methods. Although resource recovery has not received much emphasis in Arizona, if this field should develop in the future, highly trained engineers and scientists will be required for the planning, design and operation of resource recovery facilities. Training for personnel in the field of solid waste management may be accomplished both through university programs and at vocational/technical institutions and community colleges.

F. Conclusion

While more stringent enforcement of regulations and increased activity in the management of hazardous waste characterize the trend in solid waste management in Arizona, workforce growth in this area over the next five years appears to be limited. Rather, a small amount of workforce growth supplemented by more rigorous training of landfill personnel is expected to be sufficient for adequate solid waste management in Arizona.

Currently, however, training for landfill personnel is not as extensive as Bureau of Sanitation sources consider ideal, particularly for rural operations. On-site training for all landfill operators has been planned but the cost of carrying out this endeavor has been prohibitive. Thus, as a substitute or supplement to such training, EPA or technical institution sponsored short courses, either self-instructional or offered at easily accessible locations, might be an effective way of providing needed training.

VII. WASTE WATER

A. Introduction

There are approximately 550 waste water treatment plants in Arizona; an estimated 70 of these are municipally owned and the rest are privately owned. Waste water treatment plants and collection systems are classified according to the population equivalent served, degree of hazard to public health, type of facility, and degree of treatment. The chief operator or superintendent in direct charge of a treatment plant is required to be certified at the grade of the plant. Shift foremen or other operators in charge of the plant in the absence of the chief operator or superintendent are required to be certified at one grade lower. Grade IV is the highest classification and Grade I is the lowest. The grades of certification are ranked so that a person holding certification in a particular grade is permitted to operate all facilities in that particular grade and any lower grade. If a facility treats industrial waste from any industry which does not discharge into another waste water facility, its operator is required to hold the appropriate certification for the facility.

Because water is scarce in Arizona, it is treated and used with care and respect. Therefore, construction of adequate waste water treatment facilities has been stressed over the past several years and will continue to be emphasized in the future. This will help ensure that the increasing demand for water caused by population growth and industrial expansion can be met. Last year, $18 million was allocated to construction, and this year the amount is $30 million. Only secondary and tertiary treatment

facilities are built because of the water shortage. Sources in the field predict that the tertiary treatment capacity of existing facilities will be expanded by 10% per year over the next several years and that new construction of tertiary treatment facilities will also lead to a 10% annual increase. In approximately five years, tertiary treatment is expected to comprise 30% of all treatment.

The Arizona Department of Health Services (ADHS), Bureau of Water Quality Control (BWQC) has regulatory responsibility for both the waste water pollution control and water supply programs. Because available resources are inadequate to accomplish all of the BWQC's objectives with respect to waste water pollution control, the Bureau has chosen to work only on the objectives that can be supported by the available resources and to eliminate low priority objectives and those objectives which would require so large a resource expenditure that other high priority programs would have to be curtailed. Adding to the difficulty is the fact that Arizona has requested primacy for the Safe Drinking Water Act, and this program must be integrated with the existing water program and the Water Pollution Control Program. The coordination of these two programs is, at present, very time- and resource-consuming.

Because of limited funding, Arizona has not been able to accept full delegation of the construction grants program, although EPA would like to delegate more of this program to the state. Moreover, no work toward delegation of this program is expected during fiscal year 1977 because of the continued inadequacy of resources. Arizona is also unable to request delegation for the National Pollution Discharge Elimination System (NPDES) since necessary state legislation acceptable to EPA has not yet been

passed. In fiscal year 1977, ADHS is actively seeking passage of the statutory amendments adequate to obtain NPDES delegation. No additional resources would be provided if Arizona obtains delegation of this program. However, the workload would increase and other programs might need to be curtailed.

B. Workforce Profile

Information for the workforce profile was obtained through on-site and telephone interviews with personnel from the Department of Health Services, Bureau of Water Quality Control. Of particular assistance in the collection and compilation of these data were Mr. Edmund C. Garthe, Mrs. Mildred Matters, and Dr. Ronald L. Miller, all of ADHS.

As a regulatory body for the waste water pollution control program, BWQC has as a portion of its goal: to assure that properly constructed and operated community and industrial waste treatment systems are provided where necessary and to ensure that all bodies of water comply with standards established for the beneficial uses to protect health and welfare. Among the Bureau's major responsibilities for fiscal year 1977 are the following:

1) To revise design criteria for construction of waste water facilities and to review and approve waste water disposal plans and construction plans and specifications for waste water facilities to ensure that the design of waste water systems complies with state requirements;

2) To ensure proper and timely distribution of Section 201 construction grant funds and to ensure that construction of waste water facilities is in compliance with approved plans and specifications and with certification requirements;

3) To certify all NPDES permits issued by EPA and to try to obtain NPDES delegation;

4) To complete basin plans and ensure that Section 208 planning is directed toward the improvement of water quality management, is consistent with Section 303(e) basin plans, and is coordinated with the state water pollution control program;

5) To maintain a water quality monitoring network to ensure that state and federal water quality standards are met;

6) To ensure through inspections that major municipal facilities are meeting effluent requirements specified in NPDES permits;

7) To develop and implement enforcement procedures;

8) To ensure that all waste water treatment facilities are operated by personnel certified at the classification level of the plant.

The waste water pollution control program of BWQC is carried out through its headquarters in Phoenix and three field offices: the Northern Regional Office in Flagstaff, the Southern Regional Office in Tucson, and the Central Regional Office in Phoenix. A total of 17 professional and technical personnel are involved in the waste water pollution control program. The position of engineer predominates the program. The distribution of staff among existing positions is shown in the following table:

TABLE XVIII

ARIZONA DEPARTMENT OF HEALTH SERVICES

Bureau of Water Quality Control
Wastewater Pollution Control Program Personnel
Current (1976) Staffing Level

Position	1976
Engineer	11
Chemist	1
Sanitarian	1
Other	4
TOTAL	17

The engineers hold the position of public health engineer or public health engineering assistants. Approximately half are registered professional engineers and half are degreed but not registered. Degrees include chemical, sanitary, mechanical, and civil engineering. The chemist is a degreed chemist and devotes half-time to the water supply program. The 'other' category includes two administrators who are registered professional engineers, a systems analyst, and a training specialist who devotes half-time to the waste water program.

The following table illustrates the distribution of certified treatment plant operators by operator classification:

TABLE XIX

STATE OF ARIZONA

Certified Waste Water Treatment Plant Operators
Current (1976) Staffing Level

Classification	1976
I	90
II	330
III	80
IV	30
TOTAL	530

The actual total of certified operators is 530. The distribution of certified operators among the four classifications is an estimate made by BWQC personnel. Grade IV is the highest classification and Grade I the lowest. Persons holding certification may operate systems in the particular grade for which they are certified and any lower grade of system.

BWQC officials estimate that approximately 20 waste water facilities have laboratories and that perhaps five chemists are employed by these laboratories. Treatment plant operators and their assistants also conduct laboratory analysis. The State Health Laboratory has a staff of two chemists and two laboratory technicians in the Water Quality Unit. This staff spends part of its time on waste water analysis.

ADHS could not provide data on the number of treatment plant personnel other than certified operators. However, it is estimated that there may be up to 700 persons in the State of Arizona working in the field of waste water pollution control in the public and private sectors. These persons work in administration, labor, and maintenance at treatment systems, as well as in consultant capacities.

C. Workforce Projections

Workforce projections are based on the best professional judgement of personnel at ADHS. Information was obtained through on-site and telephone interviews. The persons mentioned in the previous section were, again, extremely helpful in providing workforce estimates and insights into future trends.

ADHS officials indicate that, as with the potable water program, the BWQC has a need for a doubling of staff to effectively carry out its functions. However, because of inadequate funding on the federal and state

level and anticipation that this situation will continue, no additional positions are expected to be authorized in the next five years.

TABLE XX

STATE OF ARIZONA

Waste Water Program Operations
Workforce Projections to 1982 (est.)

Position	1976	1977	1978	1979	1980	1981	%/annum turnover (average)	%/annum increase (average)
Engineer	11	11	11	11	11	11	9%	0
Chemist	1	1	1	1	1	1	n/a	0
Sanitarian	1	1	1	1	1	1	n/a	0
Other	4	4	4	4	4	4	n/a	0
TOTAL	17	17	17	17	17	17		0

The turnover rate of 9% per annum for engineers represents the loss of approximately one engineer per year. This turnover rate may increase over the next several years as some entry level engineers gain experience and find jobs in the private sector where salaries are higher. The only new hiring for water pollution control program operations at the state level will be to replace those personnel lost through employee turnover, a number which is quite low.

ADHS sources indicate that more stringent enforcement of existing state and federal regulations combined with plant construction and modifications and changes in treatment technology will result in the need for more and better trained certified treatment plant operators over the next five years. BWQC sources have provided estimates of the projected number of certified treatment plant operators by 1981. If it is assumed that growth will occur at a constant rate over the next five years, workforce projections for certified treatment plant operators are as follows:

TABLE XXI

STATE OF ARIZONA

Waste Water Treatment Plant Operators
Workforce Projections to 1982 (est.)

Classification	1976	1977	1978	1979	1980	1981	%/annum turnover (average)	%/annum increase (average)
I	90	102	114	126	138	150	n/a	11%
II	330	404	478	552	626	700	n/a	16%
III	80	154	228	302	376	450	n/a	43%
IV	30	84	138	192	246	300	n/a	67%
TOTAL	530	744	958	1172	1386	1600		25%

This table represents changes caused by both new entry and upgrading. The projected per annum growth for the next five years for certified treatment plant operators, in aggregate, is 25%. Although specific turnover rates are not available for each classification of operators, turnover is reported to be extremely high for municipal operators, approximately 35% per year. The high rate of turnover is caused primarily by low salaries. ADHS officials anticipate that higher standards and more rigorous enforcement will be accompanied by increased training and thus by higher salaries for municipal treatment plant operators. Higher salaries, in turn, are expected to contribute to a lowering of the turnover rate. However, salary decisions for operations personnel rest with the municipalities.

The increase in the number of class III and IV operators expected over the next five years is particularly large. This increase will be caused by the past and planned extensive construction of new treatment plants and the modification of existing plants which will be capable of providing secondary and tertiary treatment. These plants, of course, will require a large number of operators of the higher classifications. Also contributing to the increase in certified operators is the fact that many plants are not

adequately staffed at the present time. (As of December, 1975, 186 waste water treatment plants were operating without certified operators.) This situation will be rectified as soon as possible.

The construction of new plants and plant modifications will lead to workforce growth not only for certified operators but also for other waste water treatment personnel in such areas as administration, maintenance, and general labor. In addition, there may be some growth in the number of laboratory personnel required. However, specific workforce projections for these areas cannot be made from the available information.

In summary, ADHS sources expect no further growth in the state water pollution control program, with the possible exception of several additional laboratory personnel, because of restricted funding at the federal and state level. A 25% per annum increase in the number of certified treatment plant operators is projected for the next five years. This translates into a growth of approximately 214 persons per year. Although specific workforce profiles and projections cannot be determined for treatment plant positions other than certified operators, ADHS officials indicate that growth will occur in administrative, labor, and maintenance positions.

D. Training and Certification

BWQC employs a training specialist who works half-time in the waste water program. Training activities are conducted in cooperation with community colleges throughout the state. In five areas of the state, introductory semester courses in water treatment are offered on a regular basis. Throughout the rest of the state, training is provided in

accordance with needs as identified by ADHS. Treatment plant operators, as well as personnel involved in other aspects of waste water treatment, attend these training sessions. In fiscal year 1975, 350 people attended introductory water and waste water classes at community colleges. No breakout is available of the number of persons attending only the waste water course. In addition, one laboratory short course and three one-day seminars for operators were conducted in fiscal year 1975.

As with the potable water program, ADHS officials have identified several training needs: First, while introductory semester courses in operation are available in most areas of the state, little or no instruction is offered either in maintenance or in laboratory skills. Second, no intermediate or advanced operator semester courses are available. Third, because the overwhelming majority of the certified plant operators in the state are employed in the larger cities and towns, ADHS has placed its major efforts here and has not provided sufficient training for the more remote areas of the state. Fourth, a serious need exists for instructor training.

In response to these needs, EPA has granted ADHS funding for the development of a one-year community college curriculum. The project has been subcontracted to Pima Community College District which will develop a curriculum for a one-year certified waste water treatment plant operator training program which can be implemented in all community colleges in the state. In addition to the one year program, a training center will be built to be affiliated with Pima Community College to offer hands-on short courses. A workshop for instructors will be provided, as well. After the curriculum is developed, Pima Community College

will assist at least one other community college in presenting hands-on training in Sewer Maintenance and in Basic Construction and Design.

ADHS officials anticipate that when the program is developed, courses will be available to any person who desires to enter the training program at any community college in the state. Semester courses will be available at the community colleges on a regular basis and regional workshops will be conducted when there is sufficient demand for them. Leadership for the programs will come from the Pima Community College District. The Arizona Water and Pollution Control Association and ADHS will provide technical assistance for the programs.

After the waste water treatment plant operator program has gotten underway, ADHS officials will seek funding for a second year to the program which will provide instruction in waterworks and public works operation and administration. Graduates of the two-year program will be awarded an Associate of Applied Science degree.

E. Career Potential

Since there is no growth to be expected in the workforce employed in the state agency waste water pollution control program, career opportunities there will be extremely limited. Only turnover will be replaced, and turnover is likely to remain quite low.

Because of more stringent enforcement of existing state and federal regulations, new technology of treatment, the construction and modification of treatment plants, and inadequate staffing at present, there will be a substantial increase in the demand for certified treatment plant operators. A 25% per annum increase is expected for treatment plant operators in aggregate. Demand will be especially high for grade III and

IV operators with anticipated per annum growth for these grades being 43% and 67% respectively. Experience and training requirements for certification tend to make it difficult to skip a grade. Consequently, operators who do advance usually progress consecutively from grade I to grade IV. This being the case, ample opportunities for advancement exist for new entrants and other operators in the lower classifications. Advancement to a higher operator classification is usually accompanied by a salary increase. As job opportunities for certified operators increase, opportunities will also expand for administrative, labor and maintenance personnel.

F. Conclusion

Clearly, the area of greatest workforce need is in waste water treatment operations, labor, maintenance, and administration. This is a result of current understaffing, more strict enforcement of existing legislation, new treatment methods, changing technology, and extensive plant construction and modification. Although ADHS indicates that a doubling of its waste water pollution control staff is necessary to adequately carry out its functions and to request delegation of the construction grants and NPDES programs, no staffing growth is expected in the next five years.

Operator training is in serious need of improvement because of a past insufficiency of training as well as the development of new treatment methods and more stringent regulations. Certification requirements may become more rigorous so that treatment plants can obtain more highly qualified operators. To improve water treatment plant operator training,

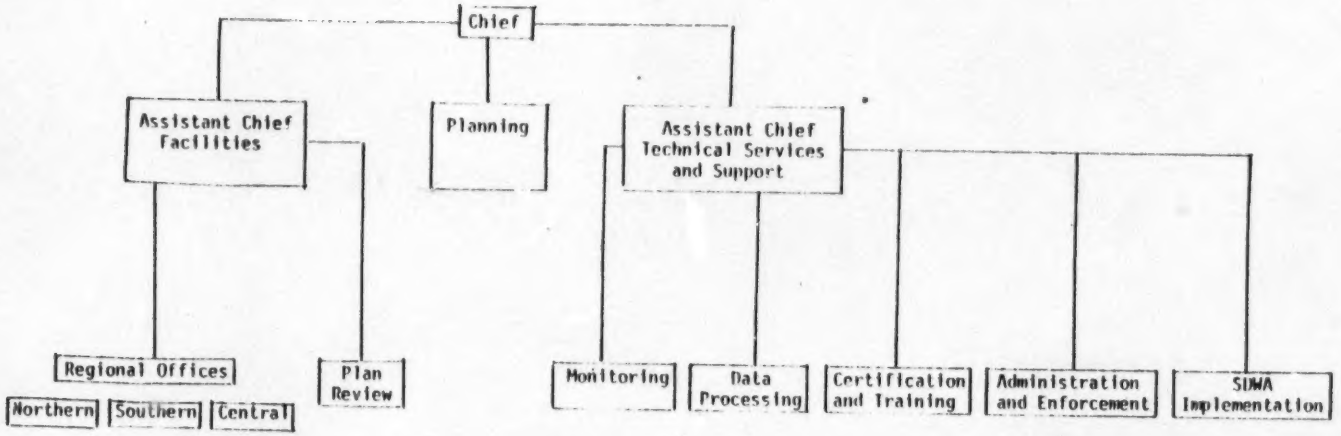
ADHS has obtained a training grant for the development of a one-year community college curriculum leading to operator certification. It is anticipated that this curriculum, supplemented by regional workshops, hands-on courses, and instructor training will help fulfill the need over the coming years for numerous, well-trained treatment plant operators.

ARIZONA DEPARTMENT OF HEALTH SERVICES

BUREAU OF WATER QUALITY CONTROL
(Waste Water and Water Supply)

ORGANIZATION CHART

Figure 4



VIII. ENERGY

A. Introduction

Almost all of Arizona's natural gas and petroleum must be imported, and there appears to be little potential for development of large oil and natural gas reserves. Contrary to popular belief, Arizona has a significant winter heating requirement, the majority of which is met by the use of natural gas which is in short supply. The only short-range energy supplement in the state, besides conservation measures, is coal which appears to be located on tribal lands administered by either the Navajo or Hopi Indians.

The Arizona State Government has three principal energy-related organizations, one for energy policy planning and operations, another for solar energy research, and the third for interagency energy activities coordination. The first is located in the Office of Economic Planning and Development (OEPAD), Planning Division, Energy Programs Section. The Energy Programs Section was created in 1974 to carry out the fuel allocation program in compliance with Federal Energy Guidelines. It is currently in the process of developing a statewide energy plan which also has been mandated by the federal government. The Section has developed and now administers a natural gas conservation program and provides much of the staff support for energy-related programs initiated by the Governor.

The second energy organization is the Arizona Solar Energy Research Commission (ASERC). ASERC was created in May of 1975 to carry out the following responsibilities:

1) Solicit the National Solar Energy Research Institute;

2) Collect, analyze, and provide information and data relating to solar energy technology and other nonpolluting, renewable energy sources;

3) Identify and encourage feasible solar energy technologies for Arizona;

4) Cooperate with all federal agencies involved in solar and advanced alternate energy technologies development;

5) Develop federal support for Arizona's solar energy activities.

ASEC has 17 members. Presently the Commission is comprised of the Chairman of the Arizona Power Authority, six representatives from Arizona's three state universities, eight representatives of the business and industrial sectors, and the President of the Arizona Senate and the Speaker of the House of Representatives as ex officio members.

The third state energy organization of note is the Interagency Energy Planning Office (IEPO). IEPO was established by the Governor in August, 1975, to coordinate the various energy activities among several state agencies concerned with energy matters. IEPO serves as a single focal point for many federal government agencies and coordinates and encourages serious energy planning efforts among the state agencies. Membership consists of 20 state agencies, representatives of which meet once a month to discuss energy policy. Member agencies are as follows: Office of Economic Planning and Development, Solar Energy Research Commission, Arizona Power Authority, Arizona Resources Information System, Arizona Water Commission, Atomic Energy Commission, Arizona Corporation Commission, Division of Emergency Services, Department of Transportation, State Land Department, Oil and Gas Conservation Commission, Department

of Mineral Resources, Department of Administration, Arizona Bureau of Mines, Arizona Board of Regents, Department of Health Services, Attorney General's Office, Department of Economic Security, Department of Education and Department of Revenue.

B. Workforce Profile

Data for the workforce profile and workforce projections (Section C) were gathered through on-site and telephone interviews with professionals in the energy field. Of particular assistance were Ms. Judi Wright of ASERC and Ms. Liza Ward of OEPAD, Energy Programs Section.

OEPAD, Energy Programs Section, has a staff of six professionals. This staff includes the Section chief, a fuel allocation officer, two natural gas project members, and two conservation planners. Originally this section was the Fuel and Energy Office with a staff of 35 persons. Although the functions of the office were expanded from fuel allocation to include energy conservation planning and the development and administration of the natural gas project, the State Legislature cut funding to allow for only three professional staff members. The other three staff persons are provided through federal funding.

ASERC has a professional staff of three persons: the executive director, a deputy director, and a public information coordinator.

As pointed out previously, IEPO has a membership of 20 representatives from the agencies listed above. This office does not have a supporting staff.

Specific workforce figures for the private sector are not available. However, according to the "Arizona Solar Energy Directory", published in November, 1976 by ASERC, there are approximately 70 architecture and

design and engineering firms involved in solar energy research and development. Sources in the field suggest that there may be one to two persons per firm working in solar energy on a part-time basis. There are approximately 70 additional firms which sell solar energy products. The three state universities conduct solar energy research. No information could be obtained concerning the workforce engaged in other forms of energy development or other energy development as it pertains to environmental pollution control and abatement activities.

C. Workforce Projections

OEPAD, Energy Programs Section, expects to experience no workforce growth over the next five years, and in fact, may lose three positions if federal funding for them ceases. ASERC may hire one engineer over the next five years. This position is presently authorized but not filled. No other staff growth is expected. Authorization for ASERC expires in 1978, but sources there expect that authority for the Commission will be renewed.

While workforce projections for the private sector are highly tentative at this time, sources in the field argue that significant growth will occur in solar and other energy development such as geo- and hydrothermal in approximately three to five years because of the shortage of natural gas and increasing utility rates.

D. Training and Certification

Training for engineers, scientists, and architects is carried out through the three state universities, the University of Arizona, Arizona State University, and Northern Arizona University.

ASERC is becoming increasingly active in providing community education in solar energy. It is preparing printed materials for public school classroom instruction and publications for national distribution designed to educate the public in the capabilities and limitations of solar equipment.

E. Career Potential

Career opportunities are expected to develop over the next three to five years for degreed and highly trained engineers, scientists, and architects in energy research, product design and development, and building design. Few career opportunities appear to be emerging for non-degreed vocational/technical personnel.

F. Conclusion

Presently, nine professional persons work full-time in energy research, planning, and conservation in the public sector and, over the next five years, this workforce may decrease. Thus, no career opportunities are to be expected in the public sector. However, Arizona's energy dependency dictates that new sources be developed. As a result, there is likely to be a growing demand for highly trained scientists, engineers, and architects. However, specific projections for this workforce cannot be made at the present time.

Selected Post Secondary Institutions With Formal Environmental Energy Programs

Arizona's higher education institutions have not yet developed an extensive selection of environmentally-related education programs either at the university or community college level. It is significant to note that the Pima Community College District is in the process of developing a curriculum for a one-year certified wastewater treatment plant operator training program. This program will be designed for replication in any Arizona Community College desiring such a program. After this program is implemented, funding will be sought for the development of a second year to the program which will provide instruction in waterworks and public works operation and management. At the university level, Northern Arizona University offers a bachelor of science degree in environmental studies. This is an interdisciplinary program for students interested in preparing themselves for vocational and professional careers in the field of environmental science in government, industry and teaching.

The above programs are examples of planned and ongoing curricula. Programs at Arizona State University and Phoenix College, which is a community college, are discussed in greater detail below.

SENIOR INSTITUTIONS

Arizona State University
Tempe, Arizona

Program: Environmental Resources in Agriculture (B.S., M.S.)

Hours required for major: Semester - (B.S.) 126, (M.S.) 30
Program Inception: not available
Staff Size: Nine professors, two associate professors, and three assistant professors.
Enrollment: (B.S.) 147, (M.S.) 20
Graduates (1976): (B.S.) 18, (M.S.) 7
Placement: not available
Graduate Work: 2

Courses (Selected)

Biological Principles and Processes
Mathematics for Social, Life, and Management Sciences
General Chemistry
Soils Laboratory
Crop Physiology
Water Resources, Quality and Utilization
Recent Advances in Environmental Quality
Environmental Horticulture
Forest and Range Ecosystems
Photosynthesis and Environmental Quality
Natural Resources Management
Natural Resources Planning

COMMUNITY COLLEGES/TECHNICAL INSTITUTIONS

Phoenix College
Phoenix, Arizona

Program: Water Treatment (Certificate, A.A.S.)

Hours required for major: Semester - (A.A.S.) 64, (Certificate) 20
Program Inception: 1965
Staff Size: Two instructors
Enrollment: 64
Graduates (1976): (Certificates) 13
Placement: all
Graduate Work: 0

Courses - Water Treatment

Introduction to Water Treatment
Introduction to Wastewater Treatment
Sanitary Chemistry Laboratory
Hydraulics of Water and Wastewater Systems
Advanced Water Treatment
Advanced Wastewater Treatment

State Legislation

ARIZONA GENERAL

TITLE:

Environmental Planning Office Act
Arizona Statutes 37-161

PURPOSE:

To create an environmental planning commission and an office of environmental planning.

DEFINITIONS:

ADMINISTERING AUTHORITY:

Office of Environmental Planning
Environmental Planning Commission

AUTHORIZATIONS:

To consult and advise the governor on environmented planning;
To prepare a land use plan;
To coordinate planning activities with other state agencies;
To evaluate natural resources monitoring in the state.

ARIZONA AIR

TITLE:

Air Pollution Control Act
Arizona Revised Statutes 36-1700

PURPOSE:

To undertake a state-wide program to control emission of air contaminants in order to protect public health, safety and welfare; and to prevent further degradation of the state's air.

DEFINITIONS:

1. Air contaminants
2. Air pollution
3. Department
4. Director
5. Hearing board
6. Person
7. Special inspection warrant

ADMINISTERING AUTHORITY:

Department of Health Services

AUTHORIZATIONS:

To administer federal funds and cooperate with federal agencies;
To monitor air quality and establish ambient air standards;
To prepare air pollution abatement implementation plan;
To issue regulations pursuant to the act to control air pollution;
To issue permits to control air pollution according to act guidelines;
To classify air contaminant sources;
To make inspections and investigations to enforce the act;
To establish motor vehicle emission levels;
To declare air pollution emergencies.

CERTIFICATION OR LICENSING:

Installation permits and operating permits are required when erecting or altering stationary source air pollution devices. A hearing board shall determine permit application disputes.

PROHIBITED ACTS:

To fail to comply with permit requirements;
To fail to comply with emission limitations and other act provisions;
To violate the provisions of emergency orders.

PENALTIES:

Fines of from $50 to $1,000.

ARIZONA AIR

TITLE:

Mandatory Annual Emissions Inspections of Motor Vehicles
Arizona Revised Statutes 36-1771

PURPOSE:

To provide for an annual emission inspection program of all motor vehicles in counties as directed by the proper authorities, and to establish needed inspection facilities.

DEFINITIONS:

1. Certificate of inspection
2. Department
3. Director
4. Fleet emissions inspection station
5. Independent contractor
6. Official emission inspector station
7. Vehicle
8. Emissions inspection station permit

ADMINISTERING AUTHORITY:

Department of Health Services

AUTHORIZATIONS:

To administer annual emissions inspection program, beginning in Maricopa and Pima counties, as a condition of registration;
To adopt emissions standards;
To issue regulations pursuant to the act;
To fix and collect inspection fees;
To authorize fleet emissions inspection stations;
To conduct random investigative tests.

PROHIBITED ACTS:

To fail to have inspection and registration of vehicle;
To make or use false certificates of inspection;
To improperly represent as a fleet emissions inspection station.

EXEMPTIONS:

Immobilized vehicles;
Vehicles over 15 years old;
New vehicles properly registered;
Private sales of vehicles.

PENALTIES:

Violations generally are misdemeanors;
Counterfeiting or false certificate violations are felony.

ARIZONA AIR

TITLE:

Motor Vehicle Emissions Inspection Facilities
Arizona Revised Statutes 36-1751

PURPOSE:

To provide for the control of motor vehicle emisssions through the establishment of inspection facilities

DEFINITIONS:

1. Motor vehicle

ADMINISTERING AUTHORITY:

Department of Health Services
Department of Transportation

AUTHORIZATIONS:

To establish motor vehicle inspection facilities in Maricopa and Pima counties;
To operate such facilities for publically-owned vehicles and voluntary private vehicles;
To prepare a study concerning needs for mandatory inspections and more facilities.

ARIZONA PESTICIDES

TITLE:

Arizona Pesticide Act
Arizona Revised Statutes 3-341

PURPOSE:

To provide for the registration and labeling of pesticides in the state.

DEFINITIONS:

1. Active ingredient
2. Adulterated
3. Antidote
4. Defoliant
5. Device
6. Fungi
7. Fungicide
8. Herbicide
9. Inert ingredient
10. Ingredient statement
11. Insect
12. Insecticide
13. Label
14. Labeling
15. Misbranded
16. Person
17. Pesticide
18. Registrant
19. Rodenticide
20. Weed

ADMINISTERING AUTHORITY:

State Chemist

AUTHORIZATIONS:

To issue regulations pursuant to the act;
To declare and determine the safety and hazard aspects of pests and pesticides;
To control the labeling, coloring, and registration of pesticides;
To issue stop sale and removal orders.

PROHIBITED ACTS:

To sell or transport unregistered, improperly packaged, misbranded, or highly toxic pesticides;
To alter or deface pesticide labels.

EXEMPTIONS:

Public officials, experimental use pesticides, pesticides for export, and special permit carriers.

PENALTIES:

Registration violations - $100 to $300.
Other violations - $100 to $1,000 and up to one year imprisonment.

ARIZONA PESTICIDES

TITLE:

Arizona Pesticide Use and Application Law
Arizona Revised Statutes 3-371

PURPOSE:

To provide greater control over agricultural pesticides, to create a Board of Pesticide Control, and to provide for certification of pesticide applicators.

DEFINITIONS:

1. Act
2. Administrator
3. Agricultural pest control advisor
4. Aircraft
5. Applicator
6. Board
7. Commercial applicator
8. Custom applicator
9. Defoliating
10. Ground equipment
11. Grower
12. Insect
13. License
14. Livestock
15. Operator
16. Permit
17. Person
18. Pest control
19. Pesticide
20. Private applicator
21. Range
22. Range livestock
23. Regulate use
24. Restricted area
25. Restricted use pesticide
26. Rodent
27. Seller of pesticides
28. Structural commercial applicator
29. Under the direct supervision of
30. Unreasonable adverse effect on the environment
31. Weed

ADMINISTERING AUTHORITY:

Board of Pesticide Control

AUTHORIZATIONS:

To issue regulations pursuant to the act;
To inspect public and private property in act enforcement;
To establish certification standards and to certify commercial and private applicators;
To regulate the use, disposal, and labeling of pesticides, including restricted use pesticides.

CERTIFICATION OR LICENSING:

Examination of qualifications for the following categories: defoliation, insects and other invertebrates, nematodes, plant growth regulators, plant pathogens, vertebrate pests, weeds.
Different standards for commercial and private applicators.

PROHIBITED ACTS:

To engage in custom application without proper license;
For growers and sellers to use certain pesticides without permit;
To store, dump or leave pesticides and containers where they may present hazard.

EXEMPTIONS:

Structural pest control operators; persons changing atmospheric conditions; fertilizer application; public officials research activities; certain weed control and sanitation efforts; emergency aircraft operations.

PENALTIES:

Civil fine for commercial applicators up to $1,000.
Criminal fines: commercial - $300 or 6 months in jail; private - $300 or 30 days in jail.

ARIZONA PESTICIDES

TITLE:

Structural Pest Control Law
Arizona Revised Statutes 32-2301

PURPOSE:

To protect the public health and safety from the unqualified use of certain chemicals and devices and to make certain that the public benefits from the use of such items.

DEFINITIONS:

1. Act
2. Administrator
3. Board
4. Household pests
5. Restricted use pesticide
6. Structural commercial applicator
7. Under the direct supervision of
8. Unreasonable adverse effects on the environment

ADMINISTERING AUTHORITY:

Structural Pest Control Board

AUTHORIZATIONS:

To make investigations in enforcing the act;
To issue regulations pursuant to the act
To establish licensing standards;
To certify commercial applicators and issue licenses.

CERTIFICATION OR LICENSING:

Examination required for license in any of the following categories: general pest control, wood destroying pest, weed control, fumigation.

PROHIBITED ACTS:

To engage in structural pest control business without license;
To use a restricted use pesticide without authority.

EXEMPTIONS:

Private persons on own property;
Public officials in course of duties;
Persons licensed under Pesticide Use and Application Law.

PENALTIES:

Civil fines of up to $1,000.
Criminal fines of up to $300 or 60 days imprisonment for license violation; $300 or 6 months for restricted use violation.

ARIZONA RADIATION

TITLE:

Control of Ionizing Radiation
Arizona Revised Statutes 30-651

PURPOSE:

To encourage the constructive development of atomic energy and radiations consistent with public health and safety;
To prohibit and control unnecessary radiation as required to protect public health and safety.

DEFINITIONS:

1. Atomic energy
2. By-product material
3. Commission
4. Electronic product
5. Executive director
6. Ionizing radiation
7. Person
8. Radiation
9. Radiation machine
10. Radioactive material
11. Source material
12. Sources of radiation
13. Special nuclear material

ADMINISTERING AUTHORITY:

Arizona Atomic Energy Commission

AUTHORIZATIONS:

To study and investigate nuclear technology uses;
To provide information on nuclear and related matters;
To issue regulations pursuant to the act, specifically dealing with control of radiation sources;
To control storage and disposal of radioactive materials.

CERTIFICATION OR LICENSING:

General or specific licenses are to be issued to users of by-product, source, special nuclear materials, or other devices or equipment. Instruction may be required for licensing.

PROHIBITED ACTS:

To use, possess or transfer radiation sources without proper licenses or registration.

PENALTIES:

Violations are misdemeanors.

NRC AGREEMENT STATE: YES

ARIZONA SOLID WASTE

TITLE:

Public Dumping Grounds Law
Arizona Revised Statutes 9-441

PURPOSE:

To control public dumping of refuse.

DEFINITIONS:

ADMINISTERING AUTHORITY:

Governing Bodies of Cities or Towns

AUTHORIZATIONS:

To designate special areas for public dumping;
To acquire or lease land for public dumping area if necesssary.

PROHIBITED ACTS:

To deposit refuse at locations other than a public dumping area.

PENALTIES:

Violations are a misdemeanor.

ARIZONA SOLID WASTE

TITLE:

Solid Waste Management Plans
Arizona Revised Statutes 36-132.01

PURPOSE:

To protect the public health of the people of the state through preparation of a comprehensive statewide solid waste management plan.

DEFINITIONS:

1. Department
2. Director

ADMINISTERING AUTHORITY:

Department of Health Services

AUTHORIZATIONS:

To prepare a comprehensive statewide solid waste management plan;
To designate local government units for the preparation of solid waste management plans;
To issue regulations pursuant to the Act.

ARIZONA WASTE WATER

TITLE:

Water Pollution Control Act
Arizona Statutes 36-1851

PURPOSE:

To protect the public health and welfare through water pollution control programs.

DEFINITIONS:

1. Administrator
2. Council
3. Department
4. Director
5. Discharge
6. Disposal system
7. Hearing officer
8. Permit
9. Person
10. Point source
11. Pollutant
12. Pollution
13. Sewage system
14. Treatment works
15. Wastes
16. Waters of the state

ADMINISTERING AUTHORITY:

Department of Health Services
Water Quality Control Council

AUTHORIZATIONS:

To act as the state lead agency in water pollution matters;
To issue regulations pursuant to the act;
To develop a comprehensive water quality standard program;
To administer the state pollutant discharge permit system;
To perform such other duties as necessary to carry out the act.

PROHIBITED ACTS:

To cause water pollution in violation of water quality standards;
To discharge into waters of the state without a permit;
To violate other regulations or act provisions.

PENALTIES:

Civil - fines of up to $10,000;
Criminal - misdemeanor and fines of up to $25,000 per day for first offense; fines of up to $50,000 per day for subsequent offenses.

ARIZONA ENERGY

TITLE:

Arizona Solar Energy Research Commission
Arizona Revised Statutes 41-3

PURPOSE:

To establish a Solar Energy Research Commission and to provide for research in the solar energy field.

DEFINITIONS:

1. Advanced alternate energy system
2. Commission
3. Executive director
4. Institute
5. Intermediate solar energy sources
6. Solar energy

ADMINISTERING AUTHORITY:

Solar Energy Research Commission

AUTHORIZATIONS:

To encourage research and collect data in the solar energy field;
To cooperate with federal agencies in carrying out the Solar Energy Research and Demonstration Act of 1974;
To identify applications of solar energy.